8
083
J

VOL. XXIV JANUARY 1940 NO. 1

Entered as second-class matter September 14, 1934, at the post office at Río Piedras, Puerto Rico under the Act of August 24, 1912.

THE JOURNAL OF AGRICULTURE
OF THE
UNIVERSITY OF PUERTO RICO

In continuation of The Journal of the
Department of Agriculture of Puerto Rico

Page

The nutritive values of some forage crops of Puerto Rico. III. Grasses. Legumes and Mixtures; by Joseph H. Axtmayer, G. Rivera Hernández, and D. H. Cook with the technical assistance of José A. Goyco and M. C. de Hernández ---------- 3

Chemical analyses of grasses; by Joseph H. Axtmayer, G. Rivera Hernández and D. H. Cook with the technical assistance of José A. Goyco and M. C. de Hernández ---------- 32

PUBLISHED BY
THE AGRICULTURAL EXPERIMENT STATION
Río Piedras, P. R.

Issued May 1940

VOL. XXIV JANUARY 1940 NO. 1

Entered as second-class matter September 14, 1934, at the post office at Río Piedras, Puerto Rico under the Act of August 24, 1912.

THE JOURNAL OF AGRICULTURE
OF THE
UNIVERSITY OF PUERTO RICO

In continuation of The Journal of the
Department of Agriculture of Puerto Rico

Page

The nutritive values of some forage crops of Puerto Rico. III. Grasses. Legumes and Mixtures; by Joseph H. Axtmayer, G. Rivera Hernández, and D. H. Cook with the technical assistance of José A. Goyco and M. C. de Hernández ---------- 3

Chemical analyses of grasses; by Joseph H. Axtmayer, G. Rivera Hernández and D. H. Cook with the technical assistance of José A. Goyco and M. C. de Hernández ---------- 32

PUBLISHED BY
THE AGRICULTURAL EXPERIMENT STATION
Río Piedras, P. R.

Issued May 1940

THE NUTRITIVE VALUES OF SOME FORAGE CROPS OF PUERTO RICO[1]

III. Grasses, Legumes and Mixtures

by Joseph H. Axtmayer, G. Rivera Hernández and D. H. Cook with the technical assistance of José A. Goyco, M. C. de Fernández, J. P. Rodríguez and F. Méndez,

from the Department of Chemistry of the School of Tropical Medicine, San Juan, Puerto Rico and the Department of Chemistry and Agronomy of the Agricultural Experiment Station, Río Piedras, Puerto Rico.

This paper is a report of data collected during the performance of seventeen digestion trials with native sheep, as a continuation of the studies of the nutritive values of forage crops begun three years ago.

Our previous publications give the details of the experimental procedures followed, and may be referred to.

MATERIALS

The forage crops studies and the trials conducted with each were as follows: Three trials with cow peas of which the first was conducted when the plant was beginning to bloom, the second during the full bloom stage, and the third during the full pod stage; three trials with Merker grass collected just after the blooming stage; one with "Yaraguá" grass during the blooming stage; two with Para grass just after the blooming stage; three with alfalfa hay which was not completely dried; one with a mixture consisting of 2/3 Merker grass and 1/3 pigeon pea in the full bloom stage; one with another mixture consisting of 2/3 Para grass and 1/3 pigeon pea in the full bloom stage; and three trials with a low nitrogen synthetic ration used for the purpose of determining the protein maintenance requirements of all the sheep used in the above trials.

---

1 Cooperative project between the Agricultural Experiment Station of the University of Puerto Rico and the School of Tropical Medicine.

Data and Discussion

The schedule followed during the course of the studies is given in Table 1.

Table 2 gives the weights of the wet and dry feed consumed or refused and the feces eliminated, the volumes of water the sheep drank and that of the urine voided during each of the ten-day trials. Except in the trial with the alfalfa hay, it will be noticed that the water intake is low compared with the urine voided. This is accounted for by the fact that the crops, as brought from the field, were wet with either rain or dew, while the alfalfa had been partially dried and stored.

Tables 3 and 4 contain data collected during the low protein trials performed to determine the protein maintenance requirements of our sheep. Various synthetic rations were tried, some of which were entirely refused or eaten sparingly by the animals. The final rations used, from which the data herein reported were collected, had the following compositions.

Rations	Trial 15	Trials 16 and 17
Merker grass straw[1]	20 %	50%
Sucrose, brown	21.4%	15%
Corn starch	21.4%	25%
Steamed bone meal	2.0%	5%
Corn oil	1.3%	3%
Cellu flour	33.9%	—
Sodium chloride	—	2%

The elimination of the Cellu flour, the decrease in the percentage of sucrose and the addition of salt seemed to produce a more appetizing ration. The values obtained for the fecal nitrogen per gram of dry matter ingested and the urinary nitrogen per kilogram of body weight compare favorably with the previously obtained values.

The percentages by weight, determined on the dry basis, of the nitrogen in the feeds fed, feeds refused, and feces and urine eliminated (the values for the latter being expressed in percentages by volume), are given in Table 8, while Table 9 contains the chemical analyses of the feces as determined on the dry basis.

1 Prepared in the laboratory by removing all the leaves from the air dried grass, cleaning the stems and then grinding them.

A summary of the data collected during the digestion trials upon which the calculations of the biological values of the proteins of the grasses and legumes studied is given in Table 10. The biological value of the protein of the cow pea increases as the plant changes from the just before blooming stage through the full bloom to the full pod stages. The Para grass protein gave a higher biological value than the Merker grass protein, both having been harvested during the same stage of maturity. In the cases of the mixtures, the Para grass —pigeon pea mixture gave a higher biological value for protein than the Merker grass— pigeon pea mixture.

Table 11 contains data relative to the digestible nutrients per 100 pounds of legumes and grasses as harvested for our trials. Among the legumes, we find that the alfalfa hay yields the highest total digestible nutrients together with a narrow nutritive ratio. Among the grasses, Yaraguá grass has the highest total digestible nutrients, but a very wide nutritive ratio.

The digestible nutrients produced per cuerda[1] of the grasses and legumes are found in Table 12, while Table 13 gives us the yields of calcium and phosphorus per cuerda and per ton of green legumes and grasses.

The net protein values of the legumes and grasses studied, fed singly or in mixtures, are given in Table 14. These values are of importance in calculating the weight of any feed necessary to maintain an animal in nitrogen equilibrium or to supply the requirements for milk production or growth. The grasses may be arranged in the following order of decreasing efficiency as regards their net-protein values if we collect all the data made available in this and previous studies: 1. Guinea grass, 0.80; 2. Merker grass, 0.78; 3. Para grass, 0.70; 4. Elephant grass, 0.64; 5. Guatemala grass, 0.64; and Yaraguá grass, 0.34.

The data of the nitrogen balance in grams as the percentage of the total intake are used to calculate the total nitrogen stored by the animals, and are contained in Table 15.

A summary of the indexes determined during the trials is given in Table 16.

The vitamin A activities of the grasses studied were also determined. The results given in Table 17 were obtained during the last two years.

---

1 One "cuerda" = 0.9712 acre.

SUMMARY AND CONCLUSIONS

The data for a total of seventeen digestion trials with sheep receiving grasses, legumes, two mixtures of these, and low protein synthetic mixtures as sole rations are reported.

The biological values for the proteins of the cow pea increase as the plant passes from the just before blooming stage through the full bloom to the full pod stages of maturities. The biological values for proteins are also higher for the grasses than for the legumes when fed singly.

The grasses studied during the last three years can be arranged in the following order of decreasing net-protein values: Guinea, Merker, Para, Elephant, Guatemala and Yaraguá.

The nutritive ratio for the Yaraguá grass is very wide due to the low digestible protein, as is shown in the data.

Alfalfa hay yields more total digestible nutrients, more crude fiber and more ether soluble extract than any of the other legumes studied.

The percentage intake of protein stored is greater with a mixture of Merker grass and pigeon pea than when the grass is fed alone.

The vitamin A activities of some grasses and legumes are reported.

LITERATURE CITED

1. **Axtmayer, Joseph H., Conrado F. Asenjo, Jr.,** and **D. H. Cook:** Jour. Agric. Univ. P. R. 22 (2) ; 95-122, 1938.

2. **Axtmayer, Joseph H., G. Rivera Hernández,** and **D. H. Cook:** Ditto. 22 (4) ; 455-481, 1938.

TABLE 1

SCHEDULE FOLLOWED STARTING SEPTEMBER 19, 1938 TO JUNE 28, 1939

Trial No.	Ration	Preliminary period		Experimental period		Animal No.
		Starts	Ends	Starts	Ends	
1	Cow pea (starting blooming)	Sept. 19	Oct. 1	Oct. 1	Oct. 11	1—2— 3— 4— 5— 6
2	Cow pea (full blooming stage)	Oct. 2	Oct. 12	Oct. 12	Oct. 22	7—8— 9—10—11—12
3	Cow pea (in pads)	Oct. 11	Oct. 22	Oct. 23	Nov. 2	1—2— 3— 4— 5— 6
4	Merker grass (after blooming)	Nov. 1	Nov. 11	Nov. 11	Nov. 21	7—8— 9—10—11—12
5	Merker grass (after blooming)	Nov. 11	Nov. 21	Nov. 22	Dec. 2	1—2— 3— 5— 6
6	Yaraguá grass (full bloom, N only)	Dec. 6	Dec. 16	Dec. 16	Dec. 26	7—8— 9—10—11—12
7	Alfalfa hay	Dec. 16	Dec. 26	Dec. 27	Jan. 6	1—2— 3— 4— 5— 6
8	Alfalfa hay	Dec. 27	Jan. 6	Jan. 7	Jan. 17	7—8— 9—10—11—12
9	Alfalfa hay	Jan. 7	Jan. 17	Jan. 18	Jan. 28	1—2— 3— 4— 5— 6
10	Merker grass (after blooming)	Jan. 17	Jan. 28	Jan. 29	Feb. 8	7—8— 9—10—13—14
11	2/3 Merker grass+1/3 pigeon pea (in flower)	Jan. 29	Feb. 8	Feb. 9	Feb. 19	1—2— 3— 4— 5— 6
12	2/3 Malojillo grass + 1/3 pigeon pea (in flower)	Feb. 9	Feb. 19	Feb. 20	March 2	7—8— 9—10—13—14
13	Para grass (after blooming stage)	Feb. 29	March 2	March 3	March 13	1—2— 3— 4— 5— 6
14	Para grass (after blooming stage)	March 2	March 13	March 14	March 24	7—8— 9—10—13—14
15	Low protein diet + 20% Merker grass straw	May 6	May 16	May 16	May 24	7—8—13—14
16	Low protein diet + 50% Merker grass straw	May 26	June 7	June 8	June 18	1—3— 4— 5— 6
17	Low protein diet + 50% Merker grass straw	June 8	June 18	June 18	June 28	7—9—10—14

TABLE 2.

TABLE 2.

TABLE 2.

SUMMARY OF THE WET AND DRY FEED AND FECES CONSUMED AND ELIMINATED, RESPECTIVELY, AND OF THE WATER INTAKE AND URINE ELIMINATION IN TEN-DAY METABOLISM EXPERIMENTS

Trial No.	Animal No.	Ration	Wet feed consumed	Feed on dry basis fed	Feed on dry basis refused	Feed on dry basis consumed	Wet feces	Dry feces	Water	Urine
			Grams	Grams	Grams	Grams	Grams	Grams	cc.	cc.
1	1	Cow pea (starting blooming)	50236	7933	2530	5403	4722	2048	120	29250
	2	do.	54432	8727	2909	5818	4832	2405	320	31660
	3	do.	60896	10578	3639	6939	6035	2724	280	36860
	4	do.	48989	7933	2616	5317	4016	2091	370	28570
	5	do.	55453	10314	4458	5856	5006	2358	460	33060
	6	do.	62370	9520	2834	6686	5515	2377	170	37080
2	7	Cow pea (full-blooming stage)	54772	10459	4526	5933	5686	2286	170	32530
	8	do.	60102	10680	3757	6923	7133	2634	120	33710
	9	do.	68493	10902	3007	7895	8076	2938	400	41190
	10	do.	66793	10791	3052	7739	7327	2830	160	39330
	11	do.	56247	10570	4182	6388	5218	2710	190	33850
	12	do.	72916	11787	3652	8135	7611	3114	280	44020
3	1	Cow pea (in full pods)	50236	14660	6858	7802	5574	2668	205	23295
	2	do.	46267	14660	7619	7041	4516	2318	285	20200
	3	do.	50123	14660	6719	7941	5388	2548	955	23610
	4	do.	46494	14660	7682	6978	4292	2322	1120	21970
	5	do.	49102	14660	7146	7514	5758	2576	1280	24375
	6	do.	58514	14660	5752	8908	6548	3140	235	27440
4	7	Merker grass (after blooming)	26309	16323	10867	5456	5231	2332	455	8085
	8	do.	28376	16323	11209	5114	4833	2150	1245	9260
	9	do.	31298	16323	10137	6186	5905	2814	550	10230
	10	do.	34247	16323	9378	6945	5795	2890	785	10770
	11	do.	29371	16323	10692	5631	4529	2426	1680	10350
	12	do.	31752	16323	10074	6249	5176	2744	2740	13460
5	1	Merker grass (after blooming)	33793	15377	8932	6445	6446	3086	1080	11455
	2	do.	29030	15377	9939	5438	4719	2488	335	9135

	11	do.	29371	16323	10692	5631	4529	2426	1680	10350
	12	do.	31752	16323	10074	6249	5176	2744	2740	13460
5	1	Merker grass (after blooming)	33793	15377	8932	6445	6446	3086	1080	11455
	2	do.	29030	15377	9939	5438	4719	2488	335	9135
	3	do.	32659	15377	9480	5897	6613	2842	2380	11975
	5	do.	29938	15377	9836	5541	6212	2656	885	10150
	6	do.	35154	15377	8692	6685	6824	3194	210	12210
6	7	Yaraguá grass (N only; full bloom)	16217	11607	7912	3695	3985	2119	1850	6160
	8	do.	17918	11607	7208	4399	3987	2151	585	5800
	9	do.	19268	11607	6719	4888	4087	2353	350	5990
	10	do.	19619	11607	6627	4980	4025	2472	500	6300
	11	do.	20515	11750	6345	5405	4800	2811	280	6450
	12	do.	20639	11750	6351	5399	4489	2682	170	6095
7	1	Alfalfa hay	8051	15332	8444	6888	5139	3004	19070	8170
	2	do.	8392	15332	8177	7155	4774	2946	16910	7410
	3	do.	8505	15332	8068	7264	5637	3088	18660	9260
	4	do.	8165	15332	8351	6981	4788	2939	15650	7870
	5	do.	8959	15332	7638	7694	6776	3316	17230	7430
	6	do.	10433	18398	9483	8915	6565	3898	18730	7660
8	7	Alfalfa hay	7825	15522	8482	7040	5978	3020	21770	8090
	8	do.	9412	15522	7276	8246	9839	3444	24710	8895
	9	do.	9639	18627	10108	8519	8038	3868	25060	9950
	10	do.	10546	18627	9097	9530	9187	3941	30375	10450
	11	do.	11794	18627	8272	10355	9331	4364	24808	10020
	12	do.	11227	18627	8632	9995	8627	4238	27900	11230
9	1	Alfalfa hay	9866	19364	10610	8754	7680	3810	27200	11920
	2	do.	9299	19364	11233	8131	6631	3436	20600	8510
	3	do.	9866	19364	10741	8623	9131	3337	25790	10130
	4	do.	8959	19364	11425	7939	6739	3517	21560	10120
	5	do.	10093	19364	10544	8820	9709	3917	23140	8350
	6	do.	12474	19364	8455	10909	8800	4474	27130	9910
10	7	Merker grass (after blooming)	32773	11529	5021	6508	5245	2780	110	14465
	8	do.	34474	11529	4642	6887	7702	2932	60	13140
	9	do.	41391	13834	5527	8307	6975	3517	180	17770
	10	do.	41617	13834	5615	8219	6435	3529	200	18660

	2	do.	29030	15377	9939	5438	4719	2488	385	9189
	3	do.	32659	15377	9480	5897	6613	2842	2380	11975
	5	do.	29938	15377	9836	5541	6212	2656	885	10150
	6	do.	35154	15377	8692	6685	6824	3194	210	12210
6	7	Yaraguá grass (N only; full bloom)	16217	11607	7912	3695	3985	2119	1850	6160
	8	do.	17918	11607	7208	4399	3987	2151	585	5800
	9	do.	19268	11607	6719	4888	4087	2353	350	5990
	10	do.	19619	11607	6627	4980	4025	2472	500	6300
	11	do.	20515	11750	6345	5405	4800	2811	280	6450
	12	do.	20639	11750	6351	5399	4489	2682	170	6095
7	1	Alfalfa hay	8051	15332	8444	6888	5139	3004	19070	8170
	2	do.	8392	15332	8177	7155	4774	2946	16910	7410
	3	do.	8505	15332	8068	7264	5637	3088	18660	9260
	4	do.	8165	15332	8351	6981	4788	2939	15650	7870
	5	do.	8959	15332	7638	7694	6776	3316	17230	7430
	6	do.	10433	18398	9483	8915	6565	3898	18730	7660
8	7	Alfalfa hay	7825	15522	8482	7040	5978	3020	21770	8090
	8	do.	9412	15522	7276	8246	9839	3444	24710	8895
	9	do.	9639	18627	10108	8519	8038	3868	25060	9950
	10	do.	10546	18627	9097	9530	9187	3941	30375	10450
	11	do.	11794	18627	8272	10355	9331	4364	24808	10020
	12	do.	11227	18627	8632	9995	8627	4238	27900	11230
9	1	Alfalfa hay	9866	19364	10610	8754	7680	3810	27200	11920
	2	do.	9299	19364	11233	8131	6631	3436	20600	8510
	3	do.	9866	19364	10741	8623	9131	3337	25790	10130
	4	do.	8959	19364	11425	7939	6739	3517	21560	10120
	5	do.	10093	19364	10544	8820	9709	3917	23140	8350
	6	do.	12474	19364	8455	10909	8800	4474	27130	9910
10	7	Merker grass (after blooming)	32773	11529	5021	6508	5245	2780	110	14465
	8	do.	34474	11529	4642	6887	7702	2932	60	13140
	9	do.	41391	13834	5527	8307	6975	3517	180	17770
	10	do.	41617	13834	5615	8219	6435	3529	200	18660
	13	do.	34814	11529	4577	6952	5392	2764	640	16410
	14	do.	34247	11529	4604	6925	8052	3137	3960	18200

	8	do.	34474	11529	4642	6887	7702	2932	60	13140
	9	do.	41391	13834	5527	8307	6975	3517	180	17770
	10	do.	41617	13834	5615	8219	6435	3529	200	18660
	13	do.	34814	11529	4577	6952	5392	2764	640	16410
	14	do.	34247	11529	4604	6925	8052	3137	3960	18200
11	1	2/3 Merker grass (blooming) +	34814	11888	5058	6830	6257	3303	605	13440
	2	1/ pigeon pea (in flower)	32432	11888	5639	6249	5446	3007	185	11360
	3	do.	35948	11888	4700	7188	9119	3289	3020	13810
	4	do.	32319	11888	5371	6517	5336	3024	700	12600
	5	do.	34814	11888	5075	6813	10751	3366	8040	9800
	6	do.	44453	13968	4939	9029	9031	4082	250	17960
12	7	2/3 Para grass + 1/3 pigeon pea	35608	11654	4552	7102	8021	3333	405	14820
	8	(in flower)	31525	11654	5537	6117	8646	2978	540	11930
	9	do.	43432	14276	5719	8557	11554	4167	170	17200
	10	do.	42071	14567	6300	8267	10480	3928	320	16740
	13	do.	38896	14567	6936	7631	12213	3752	200	12810
	14	do.	39463	14567	6710	7857	12144	3904	830	14440
13	1	Para grass (after blooming stage)	31865	11218	4956	6262	7059	2771	260	11260
	2	do.	31752	11218	4981	6237	6499	2732	120	11840
	3	do.	36855	13182	5911	7271	12651	3043	2140	10610
	4	do.	35494	14023	7059	6964	6882	2749	240	12760
	5	do.	37309	14023	6632	7391	11354	3139	380	11090
	6	do.	40144	14023	6277	7746	9446	3370	160	14440
14	7	Para grass (after blooming stage)	35834	12136	6133	6003	5304	2634	260	17530
	8	do.	33907	10113	4306	5807	8201	2734	470	14620
	9	do.	45020	12389	4626	7763	9641	3739	210	21000
	10	do.	49989	13737	5144	8593	9464	3848	220	23140
	13	do.	42298	12389	4862	7527	9249	3430	820	19200
	14	do.	44793	12389	4879	8010	10725	3511	1230	19250

TABLE 3.

LOW-PROTEIN DIET EXPERIMENT

SUMMARY OF DATA

TEN-DAY PERIOD

Trial No.	Animal No.	Ration	Wet feed consumed	Dry feed consumed	Wet feces	Dry feces	Water	Urine
			Grams	Grams	Grams	Grams	cc.	cc.
15*	7	Low protein diet + 20% Merker grass straw	3518	3236	2627	1613	6150	3198
	8		2068	1902	1666	1021	4080	1213
	13		1974	1814	1506	948	5900	2030
	14		2890	2658	1782	1267	5960	2230
16	1	Low protein diet + 50% Merker grass straw	3756	3465	2950	1809	8220	4615
	3		3391	3128	2957	1322	10290	4985
	4		3018	2784	1669	1208	6910	3965
	5		2812	2594	2769	1121	7440	2215
	6		3090	2851	2939	1261	6180	2448
17	7	Low protein diet + 50% Merker grass straw	3010	2736	2515	1536	8530	4773
	9		3782	3437	3317	1746	8950	3992
	10		3948	3588	2817	1854	9060	3915
	14		3171	2882	2527	1598	8480	5127

* Eight-day experiment.

TABLE 4.

MAINTENANCE REQUIREMENT OF LAMBS AVERAGING 18.67 KGS. IN WEIGHT, BODY NITROGEN IN FECES PER GRAM OF DRY MATTER INGESTED AND BODY NITROGEN IN URINE PER KG. OF BODY WEIGHT, BASED ON TEN-DAY TRIALS DURING WHICH NEARLY NITROGEN-FREE RATIONS WERE FED

Trial No.	Animal No.	Average weight	Dry matter ingested	Nitrogen in feed consumed	Total fecal nitrogen	Total urinary nitrogen	Total urinary and fecal nitrogen	Fecal nitrogen per gm. of dry matter ingested	Urinary nitrogen per kg. body weight
		Kg.	Grams	Percent	Grams	Grams	Grams	Grams	Grams
15	7	17.46	3236	0.130	10.39	7.84	18.23	0.00321	0.449
	8	14.27	1902	0.130	7.33	7.35	14.68	0.00386	0.515
	13	17.18	1814	0.130	7.84	14.11	21.95	0.00431	0.821
	14	18.67	2658	0.130	10.67	11.77	22.44	0.00401	0.630
16	1	18.01	3465	0.081	14.00	7.57	21.57	0.00404	0.420
	3	17.27	3128	0.081	12.66	8.82	21.48	0.00405	0.511
	4	19.65	2784	0.081	10.06	14.99	25.05	0.00361	0.763
	5	19.86	2594	0.081	10.87	9.68	20.55	0.00419	0.487
	6	21.19	2851	0.081	13.62	7.71	21.33	0.00476	0.364
17	7	14.91	2736	0.126	11.01	7.30	18.31	0.00402	0.490
	9	21.94	3437	0.126	19.38	13.81	33.19	0.00564	0.629
	10	23.64	3588	0.126	15.98	10.96	26.94	0.00445	0.463
Averages of 12 animals			Values used in the calculation of the data.					0.00418	0.545

TABLE 5

FEED

ANALYSES OF GRASSES A

Wet Basis

Trial No.	Item	Total moisture	Crude protein (N x 6.25)	Ether-soluble extract
		Percent	Percent	Percent
1	Cow pea (starting blooming)	88.34	2.09	0.54
2	Cow pea (full blooming stage)	87.80	2.45	0.62
3	Cow pea (in full pods)	83.84	2.25	0.54
4	Merker grass (after blooming)	76.01	2.07	0.75
5	do.	76.62	2.49	0.68
6	Yaraguá grass (N only)	68.41	0.99	0.78
7	Alfalfa hay	15.50	15.11	2.05
8	do.	14.45	15.72	1.90
9	do.	14.62	14.25	1.71
10	Merker grass (after blooming)	78.82	1.95	0.64
11	2/3 Merker grass (blooming) + 1/3 pigeon peas (in flower)	78.16	2.99	0.90
12	2/3 Para grass + 1/3 pigeon peas (in flower)	78.59	2.56	0.62
13	Para grass (after blooming stage)	79.39	1.70	0.51
14	do.	81.42	2.07	0.48

TABLE 4.

TABLE 6

FEED

ANALYSES OF GRASSES A

Dry Basis

Trial No.	Item	Total solids	Crude protein (N x 6.25)	Ether-soluble extract
		Percent	Percent	Percent
1	Cow pea (starting blooming)	11.66	17.94	4.59
2	Cow pea (full blooming stage)	12.20	20.06	5.07
3	Cow pea (in full pods)	16.16	13.95	3.37
4	Merker grass (after blooming)	23.99	8.63	3.12
5	do.	23.38	10.63	2.92
6	Yaraguá grass (N only)	31.59	3.13	2.48
7	Alfalfa hay	84.50	17.88	2.43
8	do.	85.55	18.38	2.22
9	do.	85.38	16.69	2.00
10	Merker grass (after blooming)	21.18	9.19	3.04
11	2/3 Merker grass (blooming) + 1/3 pigeon peas (in flower)	21.84	13.69	4.13
12	2/3 Para grass + 1/3 pigeon peas (in flower)	21.41	11.94	2.91
13	Para grass (after blooming stage)	20.61	8.25	2.47
14	do.	18.58	11.13	2.57

TABLE 5

FEED

ANALYSES OF GRASSES AND LEGUMES

Wet Basis

l re	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrate	Ash	
nt	Percent	Percent	Percent	Percent	Percent	
34	2.09	0.54	3.09	4.13	1.81	
80	2.45	0.62	2.97	4.30	1.86	
84	2.25	0.54	4.97	6.39	2.01	
01	2.07	0.75	8.66	10.06	2.45	
62	2.49	0.68	7.52	9.75	2.94	
41	0.99	0.78	12.14	15.22	2.46	
50	15.11	2.05	29.61	28.12	9.61	
45	15.72	1.90	31.75	26.79	9.39	
62	14.25	1.71	32.02	28.80	8.60	
82	1.95	0.64	7.48	8.83	2.28	
16	2.99	0.90	7.10	8.88	1.97	
59	2.56	0.62	6.77	9.51	1.95	
39	1.70	0.51	6.74	9.73	1.93	
42	2.07	0.48	4.93	8.44	2.66	

TABLE 6

FEED

ANALYSES OF GRASSES AND LEGUMES

Dry Basis

s	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrate	Ash	
nt	Percent	Percent	Percent	Percent	Percent	
66	17.94	4.59	26.51	35.46	15.50	
20	20.06	5.07	24.36	35.25	15.26	
6	13.95	3.37	30.77	39.50	12.41	
99	8.63	3.12	36.10	41.92	10.23	
38	10.63	2.92	32.16	41.72	12.57	
59	3.13	2.48	38.43	48.18	7.78	
50	17.88	2.43	35.04	33.28	11.37	
55	18.38	2.22	37.11	31.31	10.98	
38	16.69	2.00	37.50	33.74	10.07	
18	9.19	3.04	35.31	41.69	10.77	
34	13.69	4.13	32.52	40.66	9.00	
31	11.94	2.91	31.60	44.46	9.09	
51	8.25	2.47	32.69	47.21	9.38	
58	11.13	2.57	26.55	45.45	14.30	

Ash	Calcium	Phosphorus	Ca./P ratio
Percent	Percent	Percent	
1.81	0.236	0.0247	9.53
1.86	0.362	0.0257	10.62
2.01	0.174	0.0722	3.20
2.45	0.0825	0.0461	1.79
2.94	0.0905	0.0423	2.10
2.46	0.108	0.0417	2.59
9.61	0.980	0.192	5.11
9.39	0.975	0.178	5.48
8.60	1.03	0.180	5.73
2.28	0.0591	0.0428	1.38
1.97	0.115	0.0542	2.12
1.95	0.115	0.0617	1.87
1.93	0.0511	0.0437	1.17
2.66	0.0632	0.0407	1.55

Ash	Calcium	Phosphorus	Ca./P ratio
Percent	Percent	Percent	
15.50	2.02	0.212	9.53
15.26	2.24	0.211	10.62
12.41	1.43	0.447	3.20
10.23	0.344	0.192	1.79
12.57	0.380	0.181	2.10
7.78	0.342	0.132	2.59
11.37	1.16	0.227	5.11
10.98	1.14	0.208	5.48
10.07	1.21	0.211	5.73
10.77	0.279	0.202	1.38
9.00	0.525	0.248	2.12
9.09	0.538	0.288	1.87
9.38	0.248	0.212	1.17
14.30	0.340	0.219	1.55

TABLE 7

REFUSE

ANALYSES OF THE REFUSED GRASSES AND LEGUMES

Dry Basis

Trial No.	Item	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbo-hydrate	Ash	Calcium	Phospho-rus
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	Cow pea (starting blooming)	13.77	13.56	2.36	37.36	31.64	15.08	1.40	0.155
2	Cow pea (full-blooming stage)	14.33	13.69	2.61	37.57	33.73	12.40	1.59	0.164
3	Cow pea (in full pods)	17.22	10.44	1.64	43.54	34.20	10.18	1.07	0.142
4	Merker grass (after blooming)	27.51	6.44	2.16	40.19	42.46	8.75	0.258	0.171
5	do.	27.89	8.06	2.12	37.27	41.54	11.01	0.336	0.163
6	Yaraguá grass (N only)	38.40	2.42	2.11	42.93	45.60	6.94	0.278	0.119
7	Alfalfa hay	83.61	15.13	1.67	39.68	32.65	10.87	1.01	0.227
8	do.	82.43	14.06	1.57	44.49	29.23	10.55	0.981	0.215
9	do.	83.41	12.13	1.52	46.27	31.64	8.44	0.987	0.189
10	Merker grass (after blooming)	23.23	5.19	1.68	42.30	43.15	7.68	0.144	0.175
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	25.39	7.38	2.10	50.32	33.75	6.45	0.377	0.147
12	2/3 Para grass + 1/3 pigeon peas (in flower)	24.08	6.63	1.99	38.70	44.65	8.03	0.354	0.249
13	Para grass (after blooming stage)	21.92	6.50	2.19	34.98	47.35	8.98	0.189	0.173
14	do.	20.76	7.50	1.75	31.49	45.08	14.18	0.278	0.183

TABLE 8

PER CENT NITROGEN IN FEED FED, REFUSE LEFT AND FECES ON DRY BASIS

(Urine Analyses Pending)

TABLE 8

PER CENT NITROGEN IN FEED FED, REFUSE LEFT AND FECES ON DRY BASIS

(Urine Analyses, Percent by Volume)

Trial No.	Animal No.	Ration	Nitrogen in feed fed	Nitrogen in refuse left	Nitrogen in feces	Nitrogen in urine
			Percent	Percent	Percent	Percent
1	1	Cow pea (starting blooming)	2.87	2.17	1.89	0.393
	2				1.92	0.400
	3				1.97	0.416
	4				1.72	0.393
	5				1.86	0.457
	6				1.95	0.345
2	7	Cow pea (full-blooming stage)	3.21	2.19	1.91	0.414
	8				2.25	0.448
	9				2.10	0.413
	10				2.10	0.405
	11				2.15	0.510
	12				2.03	0.383
3	1	Cow pea (in full pods)	2.23	1.67	1.97	0.472
	2				1.89	0.537
	3				2.01	0.487
	4				1.96	0.509
	5				2.02	0.478
	6				2.05	0.434
4	7	Merker grass (after blooming)	1.38	1.03	1.65	0.675
	8				1.83	0.622
	9				1.64	0.672
	10				1.63	0.629
	11				1.76	0.693
	12				1.71	0.515
5	1	Merker grass (after blooming)	1.70	1.29	1.59	0.706
	2				1.56	0.730
	3				1.70	0.619
	5				1.63	0.689
	6				1.63	0.669
6	7	Yaraguá grass (full bloom; N only)	0.500	0.387	1.05	0.217
	8				1.21	0.230
	9				1.04	0.260
	10				1.09	0.264
	11				1.00	0.262
	12				1.05	0.277
7	1	Alfalfa hay	2.86	2.42	2.56	1.98
	2				2.53	2.00
	3				2.57	1.76
	4				2.45	1.94
	5				2.38	1.91
	6				2.38	2.09
8	7	Alfalfa hay	2.94	2.25	2.59	1.72
	8				2.69	1.66
	9				2.04	1.82
	10					

5	3	Merker grass (after blooming)	1.70	1.29	1.56	0.730
	5				1.70	0.619
	6				1.63	0.689
					1.63	0.669
6	7	Yaraguá grass (full bloom; N only)	0.500	0.387	1.05	0.217
	8				1.21	0.230
	9				1.04	0.260
	10				1.09	0.264
	11				1.00	0.262
	12				1.05	0.277
7	1	Alfalfa hay	2.86	2.42	2.56	1.98
	2				2.53	2.00
	3				2.57	1.76
	4				2.45	1.94
	5				2.38	1.91
	6				2.38	2.09
8	7	Alfalfa hay	2.94	2.25	2.59	1.72
	8				2.69	1.66
	9				2.04	1.82
	10				2.66	1.83
	11				2.57	1.95
	12				2.56	1.62
9	1	Alfalfa hay	2.67	1.94	2.50	1.50
	2				2.55	1.90
	3				2.66	1.63
	4				2.46	1.76
	5				2.33	1.84
	6				2.50	2.01
10	7	Merker grass (after blooming)	1.47	0.83	1.46	0.47
	8				1.53	0.53
	9				1.39	0.41
	10				1.49	0.48
	13				1.54	0.44
	14				1.52	0.40
11	1	2/3 Merker grass + 1/3 pigeon peas (in flower)	2.19	1.18	2.12	0.76
	2				2.17	0.77
	3				2.41	0.71
	4				2.14	0.84
	5				2.24	1.00
	6				2.23	0.66
	7				1.87	0.47

	3	2/3 Merker grass + 1/3 pigeon	2.19	1.18	2.41	0.41
	4	peas (in flower)			2.14	0.84
	5				2.24	1.00
	6				2.23	0.66
12	7	2/3 Para grass + 1/3 pigeon peas (in flower)	1.91	1.06	1.87	0.47
	8				2.27	0.67
	9				1.94	0.57
	10				2.01	0.59
	13				2.02	0.79
	14				1.95	0.67
13	1	Para grass, after blooming stage	1.32	1.04	1.44	0.50
	2				1.35	0.43
	3				1.58	0.54
	4				1.41	0.46
	5				1.41	0.56
	6				1.42	0.42
14	7	Para grass, after blooming stage	1.78	1.20	1.48	0.387
	8				1.68	0.466
	9				1.45	0.367
	10				1.49	0.395
	13				1.54	0.419
	14				1.52	0.420
15	7	Low-protein diet with 20% Merker grass straw	0.130		0.644	0.245
	8				0.718	0.606
	13				0.827	0.695
	14				0.842	0.528
16	1	Low-protein diet with 50% Merker grass straw	0.081		0.774	0.164
	3				0.958	0.177
	4				0.833	0.378
	5				0.970	0.437
	6				1.08	0.315
17	7	Low-protein diet with 50% Merker grass straw	0.126		0.717	0.153
	9				1.11	0.346
	10				0.862	0.280
	14				1.47	0.266

TABLE 9

PROXIMATE ANALYSES OF FECES

Dry Basis

Trial No.	Ration	Animal No.	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Carbohydrates	Ash	Calcium	Phosphorus
			Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	Cow pea (starting blooming)	1	43.79	11.81	5.04	24.72	22.90	35.53	5.15	0.558
		2	50.61	12.00	5.79	23.32	22.41	-- --	5.39	0.565
		3	45.65	12.31	6.40	21.35	23.05	36.89	5.16	0.505
		4	52.66	10.75	4.70	24.70	26.72	33.13	5.34	0.580
		5	47.90	11.63	5.62	22.46	25.34	34.95	5.32	0.636
		6	43.64	12.19	5.85	22.13	25.68	34.15	5.40	0.488
2	Cow pea (full-blooming stage)	7	40.70	11.94	4.57	21.95	26.20	35.34	5.62	0.530
		8	37.08	14.06	6.92	16.94	26.72	35.36	5.18	0.513
		9	36.64	13.13	5.12	22.68	23.32	35.75	5.58	0.479
		10	38.99	13.13	5.36	21.66	22.15	37.70	5.69	0.566
		11	52.64	13.44	5.77	19.81	23.34	37.64	5.88	0.730
		12	40.96	12.69	5.79	21.73	22.73	37.06	5.42	0.567
3	Cow pea (in full pods)	1	48.22	12.31	6.11	28.95	26.63	26.00	3.83	0.551
		2	51.46	11.81	5.75	30.77	27.28	24.39	3.53	0.610
		3	47.98	12.56	6.28	28.69	25.36	27.11	3.93	0.526
		4	54.48	12.25	6.09	32.49	24.02	25.15	3.53	0.576
		5	45.87	12.63	6.20	31.87	24.45	24.85	3.55	0.584
		6	48.40	12.81	5.35	31.44	25.75	24.65	3.35	0.491
4	Merker grass (after blooming)	7	45.55	10.31	5.10	24.27	40.54	19.78	0.645	0.487
		8	47.01	11.44	5.12	23.19	40.67	19.58	1.12	0.560
		9	48.92	10.25	5.29	26.45	41.30	16.71	1.01	0.578
		10	50.70	10.19	4.84	25.92	40.46	18.59	1.21	0.554
		11	55.42	11.00	5.05	24.28	40.08	19.59	1.15	0.609
		12	56.72	10.69	4.89	23.64	40.75	20.03	1.31	0.601
		1	48.03	9.94	3.22	22.49	38.94	25.41	1.54	0.495

		10	50.70	10.19	4.84	25.92	40.46	18.59	1.21	0.554
		11	55.42	11.00	5.05	24.28	40.08	19.59	1.15	0.609
		12	56.72	10.69	4.89	23.64	40.75	20.03	1.31	0.601
5	Merker grass (after blooming)	1	48.03	9.94	3.22	22.49	38.94	25.41	1.54	0.495
		2	53.25	9.75	2.99	22.76	38.66	25.84	1.47	0.501
		3	43.87	10.63	3.17	22.19	38.95	25.06	1.44	0.459
		5	42.88	10.19	5.22	22.39	36.56	25.64	1.46	0.474
		6	46.98	10.19	4.40	24.44	37.32	23.65	1.36	0.471
6	Yaraguá grass (in full bloom)	7	53.43	6.56	3.85	27.73	45.99	15.87	0.949	0.338
		8	53.97	7.56	4.08	25.34	46.56	16.46	1.16	0.472
		9	57.73	6.50	3.61	27.51	47.62	14.76	0.962	0.427
		10	62.03	6.81	3.72	28.82	46.15	14.50	1.04	0.434
		11	58.65	6.25	3.45	28.63	47.28	14.39	0.983	0.360
		12	59.79	6.56	3.61	28.32	46.61	14.90	1.04	0.367
7	Alfalfa hay	1	58.36	16.00	6.45	29.40	31.71	16.44	3.27	0.602
		2	62.66	15.81	4.66	30.78	32.60	16.15	3.03	0.539
		3	55.39	16.06	6.04	30.51	30.76	16.63	3.12	0.542
		4	61.78	15.31	4.91	31.97	31.50	16.31	3.15	0.556
		5	49.16	14.88	5.15	34.32	30.66	14.99	2.75	0.553
		6	59.59	14.88	4.58	35.18	31.21	14.15	2.70	0.555
8	Alfalfa hay	7	51.47	16.19	4.19	30.29	33.03	16.30	2.98	0.427
		8	34.96	16.81	4.49	29.21	32.29	17.20	2.98	0.554
		9	48.43	12.75	4.95	28.90	38.10	15.30	2.83	0.450
		10	44.48	16.63	5.40	29.15	32.30	16.52	3.02	0.492
		11	46.82	16.06	4.71	30.91	32.17	16.15	3.16	0.581
		12	49.83	16.00	4.41	30.19	32.47	16.93	3.01	0.533
9	Alfalfa hay	1	49.62	15.63	4.66	33.51	33.17	13.03	3.13	0.559
		2	52.04	15.94	5.44	32.41	32.42	13.79	3.20	0.517
		3	38.31	16.63	6.24	32.31	30.09	14.73	3.23	0.488
		4	52.29	15.38	5.30	34.08	32.01	13.23	3.01	0.488
		5	40.62	14.56	4.82	35.46	32.82	12.34	2.66	0.421
		6	51.05	15.63	5.05	34.04	32.61	12.67	2.88	0.312
10	Merker grass (after	7	53.51	9.13	4.38	25.15	40.03	21.31	0.842	0.430
		8	38.65	9.56	4.16	25.44	38.32	22.52	0.910	0.439
		9	51.51	8.69	3.67	26.27	40.07	21.20	0.710	0.343

4	Merker grass (after blooming)	1	45.55	10.31	5.10	24.27	40.54	19.78	0.645	0.487
		8	47.01	11.44	5.12	23.19	40.67	19.58	1.12	0.560
		9	48.92	10.25	5.29	26.45	41.30	16.71	1.01	0.578
		10	50.70	10.19	4.84	25.92	40.46	18.59	1.21	0.554
		11	55.42	11.00	5.05	24.28	40.08	19.59	1.15	0.609
		12	56.72	10.69	4.89	23.64	40.75	20.03	1.31	0.601
5	Merker grass (after blooming)	1	48.03	9.94	3.22	22.49	38.94	25.41	1.54	0.495
		2	53.25	9.75	2.99	22.76	38.66	25.84	1.47	0.501
		3	43.87	10.63	3.17	22.19	38.95	25.06	1.44	0.459
		5	42.88	10.19	5.22	22.39	36.56	25.64	1.46	0.474
		6	46.98	10.19	4.40	24.44	37.32	23.65	1.36	0.471
6	Yaraguá grass (in full bloom)	7	53.43	6.56	3.85	27.73	45.99	15.87	0.949	0.338
		8	53.97	7.56	4.08	25.34	46.56	16.46	1.16	0.472
		9	57.73	6.50	3.61	27.51	47.62	14.76	0.962	0.427
		10	62.03	6.81	3.72	28.82	46.15	14.50	1.04	0.434
		11	58.65	6.25	3.45	28.63	47.28	14.39	0.983	0.360
		12	59.79	6.56	3.61	28.32	46.61	14.90	1.04	0.367
7	Alfalfa hay	1	58.36	16.00	6.45	29.40	31.71	16.44	3.27	0.602
		2	62.66	15.81	4.66	30.78	32.60	16.15	3.03	0.539
		3	55.39	16.06	6.04	30.51	30.76	16.63	3.12	0.542
		4	61.78	15.31	4.91	31.97	31.50	16.31	3.15	0.556
		5	49.16	14.88	5.15	34.32	30.66	14.99	2.75	0.553
		6	59.59	14.88	4.58	35.18	31.21	14.15	2.70	0.555
8	Alfalfa hay	7	51.47	16.19	4.19	30.29	33.03	16.30	2.98	0.427
		8	34.96	16.81	4.49	29.21	32.29	17.20	2.98	0.554
		9	48.43	12.75	4.95	28.90	38.10	15.30	2.83	0.450
		10	44.48	16.63	5.40	29.15	32.30	16.52	3.02	0.492
		11	46.82	16.06	4.71	30.91	32.17	16.15	3.16	0.581
		12	49.83	16.00	4.41	30.19	32.47	16.93	3.01	0.533
9	Alfalfa hay	1	49.62	15.63	4.66	33.51	33.17	13.03	3.13	0.559
		2	52.04	15.94	5.44	32.41	32.42	13.79	3.20	0.517
		3	38.31	16.63	6.24	32.31	30.09	14.73	3.23	0.488
		4	52.29	15.38	5.30	34.08	32.01	13.23	3.01	0.488
		5	40.62	14.56	4.82	35.46	32.82	12.34	2.66	0.421
		6	51.05	15.63	5.05	34.04	32.61	12.67	2.88	0.312
10	Merker grass (after	7	53.51	9.13	4.38	25.15	40.03	21.31	0.842	0.430
		8	38.65	9.56	4.16					
		9	51.51			25.44	38.33			

		6	51.05	15.63	5.05	34.04	32.61	12.67	2.88	0.312
10	Merker grass (after blooming)	7	53.51	9.13	4.38	25.15	40.03	21.31	0.842	0.430
		8	38.65	9.56	4.16	25.44	38.32	22.52	0.910	0.439
		9	51.51	8.69	3.67	26.37	40.07	21.20	0.710	0.343
		10	55.41	9.31	3.62	26.94	38.40	21.73	0.845	0.424
		13	51.47	9.63	3.59	24.94	38.83	23.01	0.890	0.426
		14	39.94	9.50	3.90	25.92	38.51	22.17	0.869	0.421
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	1	53.15	13.25	3.66	32.33	34.90	15.86	1.36	0.485
		2	44.61	13.56	3.74	31.30	35.56	15.84	1.34	0.472
		3	37.41	15.06	3.98	31.02	33.57	16.37	1.35	0.485
		4	57.17	13.38	4.50	30.46	35.50	16.16	1.38	0.452
		5	31.58	14.00	3.71	30.30	34.89	17.10	1.16	0.457
		6	46.20	13.94	4.09	31.13	34.57	16.27	1.20	0.439
12	2/3 Para grass + 1/3 pigeon peas (in flower)	7	41.66	11.69	3.81	31.31	38.49	14.70	1.05	0.435
		8	34.74	14.19	4.20	30.91	35.29	15.41	1.21	0.445
		9	36.51	12.13	3.52	31.55	38.22	14.58	0.965	0.401
		10	38.14	12.56	3.39	32.37	37.10	14.58	1.04	0.429
		13	31.69	12.63	4.26	30.42	36.12	16.57	1.15	0.467
		14	32.47	12.19	4.05	32.51	35.53	15.72	1.14	0.492
13	Para grass, after-blooming stage	1	40.12	9.00	3.28	30.45	42.91	14.36	0.752	0.412
		2	42.84	8.44	2.58	29.91	45.61	13.46	0.682	0.380
		3	24.14	9.88	2.77	28.53	42.90	15.92	0.790	0.401
		4	38.67	8.81	2.94	28.30	45.24	14.71	0.774	0.435
		5	28.25	8.81	3.08	28.94	44.51	14.66	0.668	0.403
		6	36.20	9.00	2.99	30.06	44.47	13.48	0.655	0.453
14	Para grass, after-blooming stage	7	51.50	9.25	3.25	24.67	40.91	21.92	1.10	0.478
		8	34.58	10.50	3.66	21.60	39.74	24.50	1.19	0.507
		9	40.82	9.06	3.93	25.22	39.81	21.98	0.945	0.440
		10	41.68	9.31	3.35	24.39	39.48	23.47	1.12	0.491
		11	37.70	9.63	3.54	22.03	39.61	25.19	1.14	0.501
		12	34.03	9.50	3.79	22.64	39.75	24.32	0.958	0.494

MARY OF METABOLISM EXPERIMENTS UPON WHICH THE DETERMINATION OF BIOLOGICAL VALUES OF PROTEINS IN THE LEGUMES AND GRASSES IS BASED

erage gm.	Feed intake Wet	Feed intake Dry	Nitrogen intake	Total fecal Nitrogen	Body Nitrogen in feces	Food Nitrogen in feces	Absorbed Nitrogen	Total Nitrogen in urine	Body Nitrogen in urine	Food Nitrogen in urine	Food Nitrogen retained	Biological value	Average Biological value
	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.		
18.26	50,236	5,403	172.78	38.71	22.58	16.13	156.65	114.95	9.95	105.00	51.65	33	
19.05	54,432	5,818	187.33	46.18	24.32	21.86	165.47	126.64	10.38	116.26	49.21	30	
18.66	60,896	6,939	224.62	53.66	29.00	24.66	199.96	153.34	10.17	143.17	56.49	28	33
18.37	48,989	5,317	170.91	35.97	22.23	13.74	157.17	112.28	10.01	102.27	54.90	35	
19.45	55,453	5,856	199.27	43.86	24.48	19.38	179.89	151.08	10.60	140.48	39.41	22	
20.92	62,370	6,686	211.72	46.35	27.95	18.40	193.32	127.93	11.40	116.53	76.79	40	
14.69	54,772	5,933	236.61	43.66	24.80	18.86	217.75	134.67	8.01	126.66	91.09	42	
16.79	60,102	6,923	260.55	59.27	28.94	30.33	230.22	151.02	9.15	141.87	88.35	38	
19.68	68,493	7,895	284.10	61.70	33.00	28.70	255.40	170.11	10.73	159.38	96.02	38	40
18.82	66,793	7,739	279.55	59.43	32.35	27.08	252.47	159.29	10.26	149.03	103.44	41	
23.25	56,247	6,388	247.71	58.27	26.70	31.57	216.14	172.64	12.67	159.97	56.17	26	
25.92	72,916	8,135	298.38	63.21	34.00	29.21	269.17	168.60	14.13	154.47	114.70	43	
19.74	50,236	7,802	212.39	52.56	32.61	19.95	192.44	109.95	10.76	99.19	93.25	48	
19.85	46,267	7,041	199.68	43.81	29.43	14.38	185.30	108.47	10.82	97.65	87.65	47	
19.56	50,123	7,941	214.71	51.21	33.19	18.02	196.69	114.98	10.66	104.32	92.37	47	47
20.13	46,494	6,978	198.63	45.51	29.17	16.34	182.29	111.83	10.97	100.86	81.43	45	
21.32	49,102	7,514	207.58	52.04	31.41	20.63	186.95	116.51	11.62	104.89	82.06	44	
23.14	58,514	8,908	230.86	64.37	37.24	27.13	203.73	119.09	12.61	106.48	97.25	48	
16.39	26,309	5,456	113.33	38.48	22.81	15.67	97.66	54.57	8.93	45.64	52.02	53	
17.01	28,376	5,114	109.81	39.35	21.38	17.97	91.84	57.60	9.27	48.33	43.51	47	
20.58	31,298	6,186	120.85	46.15	25.86	20.29	100.56	68.75	11.22	57.53	43.03	43	47
20.70	34,247	6,945	128.67	47.11	29.03	18.08	110.59	67.74	11.28	56.46	54.13	49	

16.39	26,309	5,456	113.33	38.48	22.81	15.67	97.66	54.57	9.27	48.33	43.51	47
17.01	28,376	5,114	109.81	39.35	21.38	17.97	91.84	57.60	11.22	57.53	43.03	43
20.58	31,298	6,186	120.85	46.15	25.86	20.29	100.56	68.75	11.28	56.46	54.13	49
20.70	34,247	6,945	128.67	47.11	29.03	18.08	110.59	67.74	11.80	59.93	36.04	38
21.66	29,371	5,631	115.13	42.70	23.54	19.16	95.97	71.73	13.23	56.09	44.61	45
24.27	31,752	6,249	121.50	46.92	26.12	20.80	100.70	69.32				
19.62	33,793	6,445	146.19	49.07	26.94	22.13	124.06	80.87	10.69	70.18	53.88	43
19.68	29,030	5,438	133.20	38.81	22.73	16.08	117.12	66.69	10.73	55.96	61.16	52
19.62	32,659	5,897	139.12	48.31	24.65	23.66	115.46	74.13	10.69	63.44	52.02	45
21.04	29,938	5,541	134.53	43.29	23.16	20.13	114.40	69.93	11.47	58.46	55.94	49
23.53	35,154	6,685	149.28	52.06	27.94	24.12	125.16	81.68	12.82	68.86	56.30	45
15.43	16.217	3,695	27.42	22.25	15.45	6.80	20.62	13.37	8.41	4.96	15.66	76
16.50	17,918	4,399	30.15	26.03	18.39	7.64	22.51	13.34	8.99	4.35	18.16	81
20.36	19,268	4,888	32.04	24.47	20.43	4.04	28.00	15.57	11.10	4.47	23.53	84
20.64	19,619	4,980	32.39	26.94	20.82	6.12	26.27	16.63	11.25	5.38	20.89	80
22.57	20,515	5,405	34.19	28.11	22.59	5.52	28.67	16.90	12.30	4.60	24.07	84
26.03	20,639	5,399	34.17	28.16	22.57	5.59	28.58	16.88	14.19	2.69	25.89	91
20.36	8,051	6,888	234.16	76.90	28.79	48.11	186.05	161.77	11.10	150.67	35.38	19
20.24	8,392	7,155	240.62	74.53	29.91	44.62	196.00	148.20	11.03	137.17	58.83	30
20.75	8,505	7,264	243.25	79.36	30.36	49.00	194.25	162.98	11.31	151.67	42.58	22
20.42	8,165	6,981	236.41	72.01	29.18	42.83	193.58	152.68	11.13	141.55	52.03	27
21.21	8,959	7,694	253.66	78.92	32.16	46.76	206.90	141.91	11.56	130.35	76.55	37
24.33	10,433	8,915	296.69	92.77	37.26	55.51	241.18	160.09	13.26	146.83	94.35	39
17.35	7,825	7,040	266.38	78.22	29.43	48.79	217.59	139.15	9.46	129.69	87.90	40
17.92	9,412	8,246	293.52	92.64	34.47	58.17	235.35	147.66	9.77	137.89	97.46	41
22.23	9,639	8,519	320.20	78.91	35.61	43.30	276.90	181.09	12.12	168.97	107.93	39
22.23	10,546	9,530	342.95	104.83	39.84	64.99	277.96	191.24	12.12	179.12	98.84	36
25.29	11,794	10,355	361.51	112.15	43.28	68.87	292.64	195.39	13.78	181.61	111.03	38
27.56	11,227	9,995	353.41	108.49	41.78	66.71	286.70	181.93	15.02	166.91	119.79	42
22.85	9,866	8,754	311.19	95.25	36.59	58.66	252.53	178.80	12.45	166.35	86.18	34
22.34	9,299	8,131	299.10	87.62	33.99	53.63	245.47	161.69	12.18	149.51	95.96	39
22.17	9.866	8,623	308.64	88.76	36.04	52.72	255.92	165.12	12.08	153.04	102.88	40
22.17	8,959	7,939	295.37	86.52	33.19	53.33	242.04	178.11	12.08	166.03	76.01	31
23.19	10.093	8,820	312.47	91.27	36.87	54.40	258.07	153.64	12.64	141.00	117.07	45
26.20	12,474	10,909	352.99	111.85	45.60	66.25	286.74	199.19	14.28	184.91	101.83	35

TABLE 1

SUMMARY OF METABOLISM EXPERIMENTS U
OF BIOLOGICAL VALUES OF
LEGUMES AND GRASSE

Trial No.	Ration	Animal number	Body Weight			Feed intake Wet	Feed intake Dry	Nitrogen intake
			Initial Kgm.	Final Kgm.	Average Kgm.	Grams.	Grams.	Grams.
1	Cow peas (starting blooming)	1	17.80	18.71	18.26	50,236	5,403	172.78
		2	18.82	19.28	19.05	54,432	5,818	187.33
		3	18.71	18.60	18.66	60,896	6,939	224.62
		4	18.03	18.71	18.37	48,989	5,317	170.91
		5	19.28	19.62	19.45	55,453	5,856	199.27
		6	19.73	22.11	20.92	62,370	6,686	211.72
2	Cow peas (full-blooming stage)	7	14.29	15.08	14.69	54,772	5,933	236.61
		8	16.22	17.35	16.79	60,102	6,923	260.55
		9	18.94	20.41	19.68	68,493	7,895	284.10
		10	18.14	19.50	18.82	66,793	7,739	279.55
		11	23.47	23.02	23.25	56,247	6,388	247.71
		12	25.29	26.54	25.92	72,916	8,135	298.38
3	Cow peas (in full pods)	1	19.28	20.19	19.74	50,236	7,802	212.39
		2	19.50	20.19	19.85	46,267	7,041	199.68
		3	18.71	20.41	19.56	50,123	7,941	214.71
		4	19.73	20.53	20.13	46,494	6,978	198.63
		5	21.32	21.32	21.32	49,102	7,514	207.58
		6	22.68	23.59	23.14	58,514	8,908	230.86
4	Merker grass (after blooming)	7	16.33	16.44	16.39	26,309	5,456	113.33
		8	16.44	17.58	17.01	28,376	5,114	109.81
		9	20.75	20.41	20.58	31,298	6,186	120.85
		10	19.96	21.43	20.70	34,247	6,945	128.67
		11	21.09	22.23	21.66	29,371	5,631	115.13
		12	24.04	24.49	24.27	31,752	6,249	121.50
5	Merker grass (after blooming)	1	19.62	19.62	19.62	33,793	6,445	146.19
		2	19.73	19.62	19.68	29,030	5,438	133.20
		3	18.94	20.30	19.62	32,659	5,897	139.12
		5	21.21	20.87	21.04	29,938	5,541	134.53
		6	23.47	23.59	23.53	35,154	6,685	149.28
6	Yaraguá (N only) full bloom	7	15.88	14.97	15.43	16.217	3,695	27.42
		8	16.44	16.56	16.50	17,918	4,399	30.15
		9	20.75	19.96	20.36	19,268	4,888	32.04
		10	20.53	20.75	20.64	19,619	4,980	32.39
		11	22.57	22.57	22.57	20,515	5,405	34.19
		12	26.20	25.86	26.03	20,639	5,399	34.17
7	Alfalfa hay	1	19.16	21.55	20.36	8,051	6,888	234.16
		2	19.16	21.32	20.24	8,392	7,155	240.62
		3	19.50	22.00	20.75	8,505	7,264	243.25
		4	20.19	20.64	20.42	8,165	6,981	236.41
		5	20.41	22.00	21.21	8,959	7,694	253.66
		6	23.25	25.40	24.33	10,433	8,915	296.69
8	Alfalfa hay	7	16.10	18.60	17.35	7,825	7,040	266.38
		8	17.01	18.82	17.92	9,412	8,246	293.52
		9	21.21	23.25	22.23	9,639	8,519	320.20
		10	20.75	23.70	22.23	10,546	9,530	342.95
		11	24.27	26.31	25.29	11,794	10,355	361.51
		12	25.86	29.26	27.56	11,227	9,995	353.41
9	Alfalfa hay	1	22.11	23.59	22.85	9,866	8,754	311.19
		2	21.89	22.79	22.34	9,299	8,131	299.10
		3	20.98	23.36	22.17	9.866	8,623	308.64
		4	22.11	22.23	22.17	8,959	7,939	295.37
		5	22.45	23.93	23.19	10.093	8,820	312.47
		6	24.49	27.90	26.20	12,474	10,909	352.99
10	Merker grass (after blooming)	7	16.22	18.60	17.41	32.773	6,508	127.81
		8	16.90	18.60	17.75	34.474	6.887	130.95
		9	21.43	23.81	22.62	41.391	8.307	157.49
		10	21.66	24.27	22.97	41.617	8,219	156.76
		13	18.71	20.41	19.56	34.814	6.952	131.49
		14	20.30	20.75	20.53	34.247	6,925	131.27
		1	20.53	22.68	21.61	34.814	6.830	200.67
							6.249	193.81

TABLE 1

RIMENTS UPON WHICH THE DETERMINATION
ALUES OF PROTEINS IN THE
ND GRASSES IS BASED

Nitrogen intake	Total fecal Nitrogen	Body Nitrogen in feces	Food Nitrogen in feces	Absorbed Nitrogen	Total Nitrogen in urine	Body Nitrogen in urine	Food Nitrogen in urine	Food Nitrogen retained	Biological value	Average Biological value
Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.		
172.78	38.71	22.58	16.13	156.65	114.95	9.95	105.00	51.65	33	
187.33	46.18	24.32	21.86	165.47	126.64	10.38	116.26	49.21	30	
224.62	53.66	29.00	24.66	199.96	153.34	10.17	143.17	56.49	28	33
170.91	35.97	22.23	13.74	157.17	112.28	10.01	102.27	54.90	35	
199.27	43.86	24.48	19.38	179.89	151.08	10.60	140.48	39.41	22	
211.72	46.35	27.95	18.40	193.32	127.93	11.40	116.53	76.79	40	
236.61	43.66	24.80	18.86	217.75	134.67	8.01	126.66	91.09	42	
260.55	59.27	28.94	30.33	230.22	151.02	9.15	141.87	88.35	38	
284.10	61.70	33.00	28.70	255.40	170.11	10.73	159.38	96.02	38	40
279.55	59.43	32.35	27.08	252.47	159.29	10.26	149.03	103.44	41	
247.71	58.27	26.70	31.57	216.14	172.64	12.67	159.97	56.17	26	
298.38	63.21	34.00	29.21	269.17	168.60	14.13	154.47	114.70	43	
212.39	52.56	32.61	19.95	192.44	109.95	10.76	99.19	93.25	48	
199.68	43.81	29.43	14.38	185.30	108.47	10.82	97.65	87.65	47	
214.71	51.21	33.19	18.02	196.69	114.98	10.66	104.32	92.37	47	47
198.63	45.51	29.17	16.34	182.29	111.83	10.97	100.86	81.43	45	
207.58	52.04	31.41	20.63	186.95	116.51	11.62	104.89	82.06	44	
230.86	64.37	37.24	27.13	203.73	119.09	12.61	106.48	97.25	48	
113.33	38.48	22.81	15.67	97.66	54.57	8.93	45.64	52.02	53	
109.81	39.35	21.38	17.97	91.84	57.60	9.27	48.33	43.51	47	
120.85	46.15	25.86	20.29	100.56	68.75	11.22	57.53	43.03	43	47
128.67	47.11	29.03	18.08	110.59	67.74	11.28	56.46	54.13	49	
115.13	42.70	23.54	19.16	95.97	71.73	11.80	59.93	36.04	38	
121.50	46.92	26.12	20.80	100.70	69.32	13.23	56.09	44.61	45	
146.19	49.07	26.94	22.13	124.06	80.87	10.69	70.18	53.88	43	
133.20	38.81	22.73	16.08	117.12	66.69	10.73	55.96	61.16	52	
139.12	48.31	24.65	23.66	115.46	74.13	10.69	63.44	52.02	45	47
134.53	43.29	23.16	20.13	114.40	69.93	11.47	58.46	55.94	49	
149.28	52.06	27.94	24.12	125.16	81.68	12.82	68.86	56.30	45	
27.42	22.25	15.45	6.80	20.62	13.37	8.41	4.96	15.66	76	
30.15	26.03	18.39	7.64	22.51	13.34	8.99	4.35	18.16	81	
32.04	24.47	20.43	4.04	28.00	15.57	11.10	4.47	23.53	84	83
32.39	26.94	20.82	6.12	26.27	16.63	11.25	5.38	20.89	80	
34.19	28.11	22.59	5.52	28.67	16.90	12.30	4.60	24.07	84	
34.17	28.16	22.57	5.59	28.58	16.88	14.19	2.69	25.89	91	
234.16	76.90	28.79	48.11	186.05	161.77	11.10	150.67	35.38	19	
240.62	74.53	29.91	44.62	196.00	148.20	11.03	137.17	58.83	30	
243.25	79.36	30.36	49.00	194.25	162.98	11.31	151.67	42.58	22	33
236.41	72.01	29.18	42.83	193.58	152.68	11.13	141.55	52.03	27	
253.66	78.92	32.16	46.76	206.90	141.91	11.56	130.35	76.55	37	
296.69	92.77	37.26	55.51	241.18	160.09	13.26	146.83	94.35	39	
266.38	78.22	29.43	48.79	217.59	139.15	9.46	129.69	87.90	40	
293.52	92.64	34.47	58.17	235.35	147.66	9.77	137.89	97.46	41	
320.20	78.91	35.61	43.30	276.90	181.09	12.12	168.97	107.93	39	39
342.95	104.83	39.84	64.99	277.96	191.24	12.12	179.12	98.84	36	
361.51	112.15	43.28	68.87	292.64	195.39	13.78	181.61	111.03	38	
353.41	108.49	41.78	66.71	286.70	181.93	15.02	166.91	119.79	42	
311.19	95.25	36.59	58.66	252.53	178.80	12.45	166.35	86.18	34	
299.10	87.62	33.99	53.63	245.47	161.69	12.18	149.51	95.96	39	
308.64	88.76	36.04	52.72	255.92	165.12	12.08	153.04	102.88	40	37
295.37	86.52	33.19	53.33	242.04	178.11	12.08	166.03	76.01	31	
312.47	91.27	36.87	54.40	258.07	153.64	12.64	141.00	117.07	45	
352.99	111.85	45.60	66.25	286.74	199.19	14.28	184.91	101.83	35	
127.81	40.59	27.20	13.39	114.42	67.99	9.49	58.50	55.92	49	
130.95	44.86	28.79	16.07	114.88	69.64	9.67	59.97	54.91	48	
157.49	48.89	34.72	14.17	143.32	72.86	12.33	60.53	82.79	58	49
156.76	52.58	34.36	18.22	138.54	89.57	12.52	77.05	61.49	44	
181.49	42.57	29.06	13.51	117.98	72.20	10.66	61.54	56.44	48	
131.27	47.68	28.95	18.73	112.54	72.80	11.19	61.61	50.93	45	
200.67	70.02	28.55	41.47	159.20	102.14	11.78	90.36	68.84	43	
193.81	65.25	26.12	39.13	154.68	87.47	11.40	76.07	78.61	51	

5	Merker grass (after blooming)	2	19.73	19.62	19.68	29,030	5,438	133.2
		3	18.94	20.30	19.62	32,659	5,897	139.1
		5	21.21	20.87	21.04	29,938	5,541	134.5
		6	23.47	23.59	23.53	35,154	6,685	149.2
6	Yaraguá (N only) full bloom	7	15.88	14.97	15.43	16.217	3,695	27.4
		8	16.44	16.56	16.50	17,918	4,399	30.1
		9	20.75	19.96	20.36	19,268	4,888	32.0
		10	20.53	20.75	20.64	19,619	4,980	32.3
		11	22.57	22.57	22.57	20,515	5,405	34.1
		12	26.20	25.86	26.03	20,639	5,399	34.1
7	Alfalfa hay	1	19.16	21.55	20.36	8,051	6,888	234.1
		2	19.16	21.32	20.24	8,392	7,155	240.6
		3	19.50	22.00	20.75	8,505	7,264	243.2
		4	20.19	20.64	20.42	8,165	6,981	236.4
		5	20.41	22.00	21.21	8,959	7,694	253.6
		6	23.25	25.40	24.33	10,433	8,915	296.6
8	Alfalfa hay	7	16.10	18.60	17.35	7,825	7,040	266.3
		8	17.01	18.82	17.92	9.412	8,246	293.5
		9	21.21	23.25	22.23	9,639	8,519	320.2
		10	20.75	23.70	22.23	10,546	9,530	342.95
		11	24.27	26.31	25.29	11,794	10,355	361.51
		12	25.86	29.26	27.56	11,227	9,995	353.41
9	Alfalfa hay	1	22.11	23.59	22.85	9,866	8,754	311.19
		2	21.89	22.79	22.34	9,299	8,131	299.10
		3	20.98	23.36	22.17	9.866	8,623	308.64
		4	22.11	22.23	22.17	8,959	7,939	295.37
		5	22.45	23.93	23.19	10.093	8.820	312.47
		6	24.49	27.90	26.20	12,474	10,909	352.99
10	Merker grass (after blooming)	7	16.22	18.60	17.41	32.773	6,508	127.81
		8	16.90	18.60	17.75	34.474	6.887	130.95
		9	21.43	23.81	22.62	41.391	8.307	157.49
		10	21.66	24.27	22.97	41.617	8,219	156.76
		13	18.71	20.41	19.56	34.814	6.952	131.49
		14	20.30	20.75	20.53	34.247	6,925	131.27
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	1	20.53	22.68	21.61	34.814	6.830	200.67
		2	20.07	21.77	20.92	32,432	6.249	193.81
		3	20.07	22.23	21.15	35,948	7,188	204.89
		4	20.64	21.89	21.27	32.319	6,517	196.97
		5	23.47	22.68	23.08	34,814	6,813	200.46
		6	25.63	25.97	25.80	44,453	9.029	247.62
12	2/3 Pará grass + 1/3 pigeon peas (in flower)	7	19.73	20.87	20.30	35,608	7.102	174.34
		8	18.94	19.50	19.22	31,525	6.117	163.90
		9	25.63	26.20	25.92	43,432	8,557	212.05
		10	24.95	25.86	25.41	42.071	8,267	211.45
		13	22.00	21.66	21.83	38,896	7,631	204.71
		14	23.13	22.45	22.79	39,463	7.857	207.10
13	Pará grass (after-blooming stage)	1	20.98	22.91	21.95	31,865	6,262	96.54
		2	20.53	22.11	21.32	31.752	6,237	96.28
		3	20.53	22.57	21.55	36.855	7,271	112.53
		4	21.21	22.34	21.78	35,494	6.964	111.69
		5	24.49	24.38	24.44	37,309	7.391	116.13
		6	26.65	28.46	27.56	40,144	7,746	119.82
14	Pará grass (after-blooming stage)	7	20.30	21.21	20.76	35,834	6,003	142.42
		8	18.94	19.05	19.00	33.907	5,807	128.34
		9	27.10	25.97	26.54	45,020	7,763	165.01
		10	25.86	26.20	26.03	49.989	8,593	182.79
		13	23.25	22.23	22.74	42,298	7.527	162.18
		14	23.36	23.70	23.53	44,793	8,010	167.97

133.20	38.81	22.73	16.08	117.12	66.69	10.73	55.96	61.10	62	
139.12	48.31	24.65	23.66	115.46	74.13	10.69	63.44	52.02	45	47
134.53	43.29	23.16	20.13	114.40	69.93	11.47	58.46	55.94	49	
149.28	52.06	27.94	24.12	125.16	81.68	12.82	68.86	56.30	45	
27.42	22.25	15.45	6.80	20.62	13.37	8.41	4.96	15.66	76	
30.15	26.03	18.39	7.64	22.51	13.34	8.99	4.35	18.16	81	83
32.04	24.47	20.43	4.04	28.00	15.57	11.10	4.47	23.53	84	
32.39	26.94	20.82	6.12	26.27	16.63	11.25	5.38	20.89	80	
34.19	28.11	22.59	5.52	28.67	16.90	12.30	4.60	24.07	84	
34.17	28.16	22.57	5.59	28.58	16.88	14.19	2.69	25.89	91	
234.16	76.90	28.79	48.11	186.05	161.77	11.10	150.67	35.38	19	
240.62	74.53	29.91	44.62	196.00	148.20	11.03	137.17	58.83	30	33
243.25	79.36	30.36	49.00	194.25	162.98	11.31	151.67	42.58	22	
236.41	72.01	29.18	42.83	193.58	152.68	11.13	141.55	52.03	27	
253.66	78.92	32.16	46.76	206.90	141.91	11.56	130.35	76.55	37	
296.69	92.77	37.26	55.51	241.18	160.09	13.26	146.83	94.35	39	
266.38	78.22	29.43	48.79	217.59	139.15	9.46	129.69	87.90	40	
293.52	92.64	34.47	58.17	235.35	147.66	9.77	137.89	97.46	41	39
320.20	78.91	35.61	43.30	276.90	181.09	12.12	168.97	107.93	39	
342.95	104.83	39.84	64.99	277.96	191.24	12.12	179.12	98.84	36	
361.51	112.15	43.28	68.87	292.64	195.39	13.78	181.61	111.03	38	
353.41	108.49	41.78	66.71	286.70	181.93	15.02	166.91	119.79	42	
311.19	95.25	36.59	58.66	252.53	178.80	12.45	166.35	86.18	34	
299.10	87.62	33.99	53.63	245.47	161.69	12.18	149.51	95.96	39	37
308.64	88.76	36.04	52.72	255.92	165.12	12.08	153.04	102.88	40	
295.37	86.52	33.19	53.33	242.04	178.11	12.08	166.03	76.01	31	
312.47	91.27	36.87	54.40	258.07	153.64	12.64	141.00	117.07	45	
352.99	111.85	45.60	66.25	286.74	199.19	14.28	184.91	101.83	35	
127.81	40.59	27.20	13.39	114.42	67.99	9.49	58.50	55.92	49	
130.95	44.86	28.79	16.07	114.88	69.64	9.67	59.97	54.91	48	49
157.49	48.89	34.72	14.17	143.32	72.86	12.33	60.53	82.79	58	
156.76	52.58	34.36	18.22	138.54	89.57	12.52	77.05	61.49	44	
131.49	42.57	29.06	13.51	117.98	72.20	10.66	61.54	56.44	48	
131.27	47.68	28.95	18.73	112.54	72.80	11.19	61.61	50.93	45	
200.67	70.02	28.55	41.47	159.20	102.14	11.78	90.36	68.84	43	
193.81	65.25	26.12	39.13	154.68	87.47	11.40	76.07	78.61	51	45
204.89	79.26	30.05	49.21	155.68	98.05	11.53	86.52	69.16	44	
196.97	64.71	27.24	37.47	159.50	105.84	11.60	94.24	65.26	41	
200.46	75.40	28.48	46.92	153.54	98.00	12.58	85.42	68.12	44	
247.62	91.03	37.74	53.29	194.33	118.54	14.06	104.48	89.85	46	
174.34	62.33	29.69	32.64	141.70	69.65	11.06	58.59	83.11	59	
163.90	67.60	25.57	42.03	121.87	79.93	10.47	69.46	52.41	43	49
212.05	80.84	35.77	45.07	166.98	98.04	14.13	83.91	83.07	50	
211.45	78.95	34.56	44.39	167.06	98.77	13.85	84.92	82.14	49	
204.71	75.79	31.90	43.89	160.82	101.20	11.90	89.30	71.52	44	
207.10	76.13	32.84	43.29	163.81	96.75	12.42	84.33	79.48	48	
96.54	39.90	26.18	13.72	82.82	56.30	11.96	44.34	38.48	46	
96.28	36.88	26.07	10.81	85.47	50.91	11.62	39.29	46.18	54	53
112.53	48.08	30.39	17.69	94.84	57.29	11.74	45.55	49.29	52	
111.69	38.76	29.11	9.65	102.04	58.70	11.87	46.83	55.21	54	
116.13	44.26	30.89	13.37	102.76	62.10	13.32	48.78	53.98	53	
119.82	48.53	32.38	16.15	103.67	60.65	15.02	45.63	58.04	56	
142.42	38.98	25.09	13.89	128.53	67.80	11.31	56.49	72.04	56	
128.34	45.93	24.27	21.66	106.68	68.13	10.36	57.77	48.91	46	53
165.01	54.22	32.45	21.77	143.24	77.07	14.46	62.61	80.63	56	
182.79	57.34	35.92	21.42	161.37	91.40	14.19	77.21	84.16	52	
162.18	52.82	31.46	21.36	140.82	80.45	12.39	68.06	72.76	52	
167.97	53.37	33.48	19.89	148.08	80.85	12.82	68.03	80.05	54	

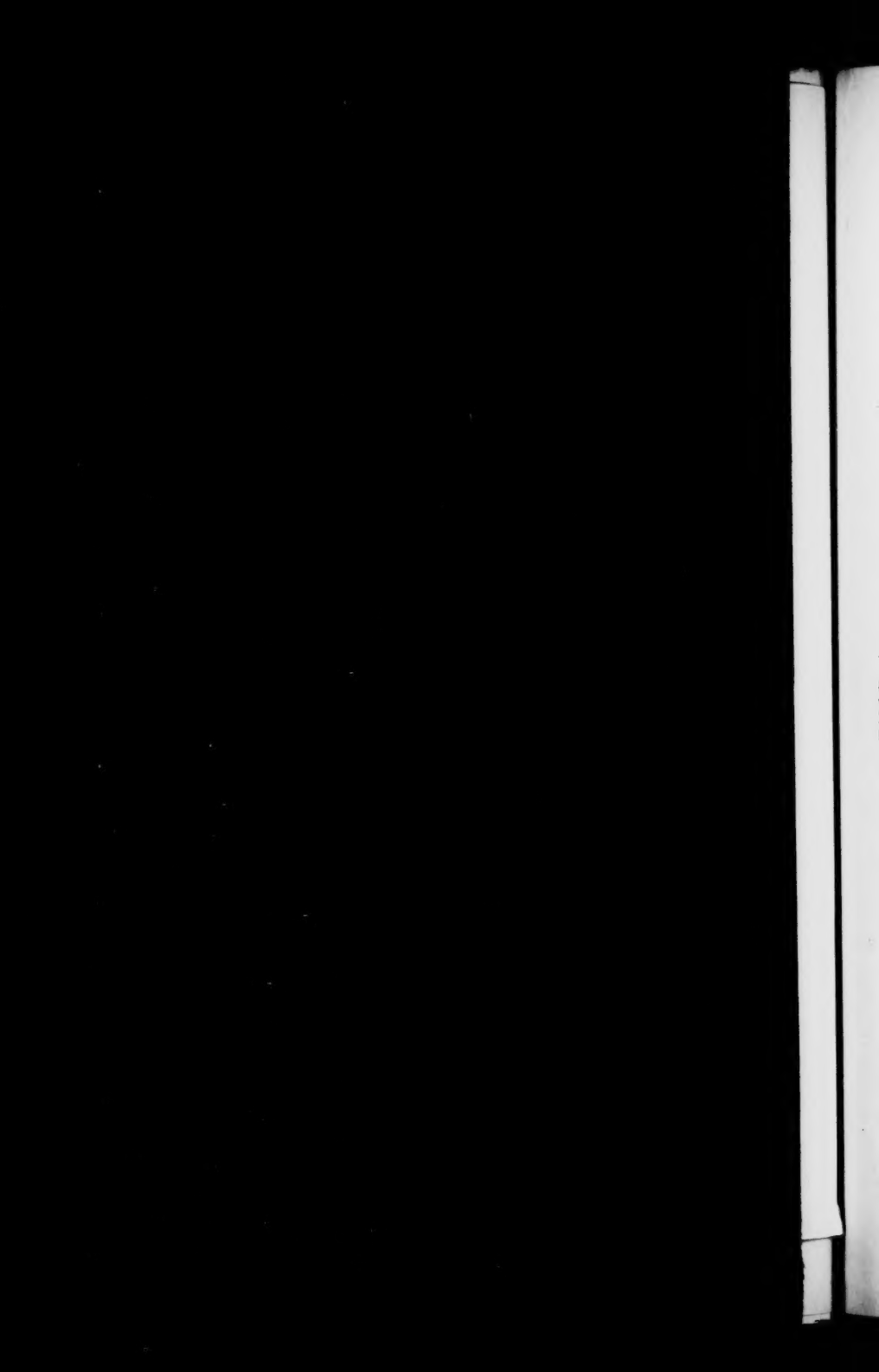

TABLE 11

DIGESTIBLE NUTRIENTS IN 100 LBS. OF LEGUMES AND GRASSES AS CUT

Trial No.	Ration	Digestible Nutrients						Nutritive ratio
		Dry matter	Crude protein	Carbohydrates		Ether-soluble extract	Total * digestible nutrients	
				Crude fiber	N-free extract			
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	
1	Cow pea (starting blooming)	7.11	1.61	1.73	3.10	0.34	7.21	3.48
2	Cow pea (full-blooming stage)	7.56	1.94	1.60	3.18	0.41	7.64	2.94
3	Cow pea (in full pods)	10.83	1.71	2.24	5.18	0.32	9.85	4.76
4	Merker grass (after blooming)	13.67	1.30	5.46	5.73	0.41	13.41	9.32
5	do.	12.16	1.67	4.14	5.56	0.39	12.25	6.34
6	Yaraguá grass (full bloom)	15.48	0.18	6.80	8.37	0.29	16.00	87.90
7	Alfalfa hay	48.17	10.43	15.99	17.15	0.64	45.01	3.32
8	do.	49.62	11.00	18.10	15.27	0.57	45.65	3.15
9	do.	49.52	9.98	15.05	17.86	0.24	43.43	3.35
10	Merker grass (after blooming)	12.07	1.31	4.79	5.21	0.37	12.14	8.27
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	11.58	1.91	1.70	5.68	0.60	10.64	4.57
12	2/3 Para grass + 1/3 pigeon peas (in flower)	10.92	1.59	2.78	5.71	0.30	10.76	5.77
13	Para grass (after blooming)	11.95	1.04	3.98	6.03	0.28	11.68	10.23
14	do.	10.03	1.41	2.66	5.06	0.23	9.65	5.84

* Total digestible nutrients including fat x 2.25.

TABLE 12

DIGESTIBLE NUTRIENTS PRODUCED PER CUERDA* OF GREEN LEGUMES AND GRASSES

Trial No.	Ration	Yield per cuerda	Dry matter	Crude protein (N x 6.25)	Crude fiber	N-free extract	Ether-soluble extract	Total digestible matter
		Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1	Cow pea (starting blooming)	22,200	1,578	357	384	688	75	1,598
2	Cow pea (full-blooming stage)	22,200	1,678	431	355	706	91	1,697
	AVERAGE	22,200	1,628	394	370	697	83	1,648
3	Cow pea (full pods)	16,400	1,776	280	367	850	52	1,614
4	Merker grass (after blooming)	64,000	8,749	832	3,494	3,667	262	8,583
5	do.	64,000	7,782	1,069	2,650	3.558	250	7,840
	AVERAGE	64,000	8,266	951	3,072	3,613	256	8,212
6	Yaraguá grass (full bloom)	42,000	6,502	76	2,853	3,515	122	6,722
7	Alfalfa hay	13,600	6,551	1,418	2,175	2,332	87	6,121
8	do.	13,600	6,748	1,496	2,462	2,077	78	6,211
9	do.	13,600	6,735	1,357	2,047	2,429	33	5,907
	AVERAGE	13,600	6,678	1,424	2,228	2,279	66	6,080
10	Merker grass (after blooming)	64,000	7,725	838	3,066	3,334	237	7,771
13	Para grass (after blooming)	56,000	6,692	582	2,229	3,377	157	6,541
14	do.	56,000	5,617	790	1,490	2,834	129	5,404
	AVERAGE	56,000	6,155	686	1,860	3,106	143	5,973

* Land measure equivalent to 0.9712 acre.

TABLE 13

YIELD OF CALCIUM AND PHOSPHORUS PER CUERDA* AND PER TON OF GREEN LEGUMES AND GRASSES°

Trial No.	Ration	Green forage per cuerda	Dry forage per cuerda	Yield per cuerda		Yield per ton	
				Calcium	Phosphorus	Calcium	Phosphorus
		Tons	Pounds	Pounds	Pounds	Pounds	Pounds
1	Cow pea (starting blooming)	11.1	2,589	52.39	5.48	4.72	0.494
2	Cow pea (full-blooming stage)	11.1	2,708	80.36	5.71	7.24	0.514
	AVERAGE	11.1	2,649	66.38	5.60	5.98	0.504
3	Cow pea (in full pods)	8.2	2,650	28.54	11.81	3.48	1.44
4	Merker grass (after blooming)	32.0	15,354	52.80	29.50	1.65	0.922
5	do.	32.0	14,963	57.92	27.07	1.81	0.846
	AVERAGE	32.0	15,159	55.36	28.29	1.73	0.884
6	Yaraguá grass (full bloom)	21.0	13,268	45.36	17.51	2.16	0.834
7	Alfalfa hay	6.8	11,492	133.28	26.11	19.60	3.84
8	do.	6.8	11,635	132.60	24.21	19.50	3.56
9	do.	6.8	11,612	140.08	24.48	20.60	3.60
	AVERAGE	6.8	11,580	135.32	24.94	19.90	3.67
10	Merker grass (after blooming)	32.0	13,555	37.76	27.39	1.18	0.856
13	Para grass (after blooming)	28.0	11,542	28.56	24.47	1.02	0.874
14	do.	28.0	10,405	35.28	22.79	1.26	0.814
	AVERAGE	28.0	10,974	31.92	23.63	1.14	0.844

* Unit of land measure equivalent to 0.9712 acre.

° Yields obtained from the Experiment Station.

NET PROTEIN VALUES OF THE LEGUMES AND GRASSES FED SINGLY AND IN COMBINATION TO LAMBS

Wet basis

Trial No.	Item	Protein in feed consumed	Coefficient of apparent digestibility	Digestible protein	Average biological value of digestible protein	Net protein content
		Percent		Percent		Percent
1	Cow pea (starting blooming)	2.09	77	1.61	33	0.531
2	Cow pea (full-blooming stage)	2.45	79	1.94	40	0.776
3	Cow pea (in full pods)	2.25	76	1.71	47	0.804
4	Merker grass (after blooming)	2.07	63	1.30	47	0.611
5	do.	2.49	67	1.67	47	0.785
10	do.	1.95	67	1.31	49	0.642
	AVERAGE				48	0.679
6	Yaraguá grass	0.99	18	0.18	83	0.149
7	Alfalfa hay	15.11	69	10.43	33	3.44
8	do.	15.72	70	11.00	39	4.29
9	do.	14.25	70	9.98	37	3.69
	AVERAGE	15.03	70	10.47	36	3.81
11	2/3 Merker grass + 1/3 pigeon peas (in flower)	2.99	64	1.91	45	0.860
12	2/3 Para grass + 1/3 pigeon peas (in flower)	2.56	62	1.59	49	0.779
13	Pará grass (after blooming)	1.70	61	1.04	53	0.551
14	do.	2.07	68	1.41	53	0.747
	AVERAGE	1.89	65	1.23	53	0.649

TABLE 15

NITROGEN BALANCE DATA WITH PERCENTAGES OF INTAKE COMPUTED FOR ALL THE FEEDING STUFFS WHEN FED TO LAMBS

Trial No.	Item	Animal No.	Feed eaten	Nitrogen consumed	Nitrogen voided in			Nitrogen balance	Intake stored
					Feces	Urine	Total outgo		
			Grams	Grams	Grams	Grams	Grams	Grams	Percent
1	Cow pea (starting blooming)	1	5403	172.78	38.71	114.95	153.66	19.12	11.07
		2	5818	187.33	46.18	126.64	172.82	14.51	7.75
		3	6939	224.62	53.66	153.34	207.00	17.62	7.84
		4	5317	170.91	35.97	112.28	148.25	22.66	13.26
		5	5856	199.27	43.86	151.08	194.94	4.33	2.17
		6	6686	211.72	46.35	127.93	174.28	37.44	17.68
	AVERAGE		6003	194.44	44.12	131.04	175.16	19.28	9.96
2	Cow pea (full-blooming stage)	7	5933	236.61	43.66	134.67	178.33	58.28	24.63
		8	6923	260.55	59.27	151.02	210.29	50.26	19.31
		9	7895	284.10	61.70	170.11	231.81	52.29	18.41
		10	7739	279.55	59.43	159.29	218.72	60.83	21.76
		11	6388	247.71	58.27	172.64	230.91	16.80	6.78
		12	8135	298.38	63.21	168.60	231.81	66.57	22.31
	AVERAGE		7169	267.65	57.59	159.39	216.98	50.84	18.87
3	Cow pea (in full pods)	1	7802	212.39	52.56	109.95	162.51	49.88	23.49
		2	7041	199.68	43.81	108.47	152.28	47.40	23.74
		3	9941	214.71	51.21	114.98	166.19	48.52	22.60
		4	6978	198.63	45.51	111.83	157.34	41.29	20.79
		5	7514	209.58	52.04	116.51	168.55	41.03	19.58
		6	8908	230.86	64.37	119.09	183.46	47.40	20.53
	AVERAGE		8031	210.98	51.58	113.47	165.06	45.92	21.79
4	Merker grass (after blooming)	7	5456	113.33	38.48	54.57	93.05	20.28	17.89
		8	5114	109.81	39.35	57.60	96.95	12.86	11.71
		9	6186	120.85	46.15	68.75	114.90	5.95	4.92
		10	6945	128.67	47.11	67.74	114.85	13.82	10.74
		11	5631	115.13	42.70	71.73	114.43	0.70	0.61
		12	6249	121.50	46.92	69.32	116.24	5.26	4.33
	AVERAGE		5930	118.22	43.45	64.95	108.40	9.81	8.37
5	Merker grass (after blooming)	1	6445	146.19	49.07	80.87	129.94	16.25	11.12
		2	5438	133.20	38.81	66.69	105.50	27.70	20.80
		3	5897	139.12	48.31	74.13	122.44	16.68	11.99
		5	5541	134.53	43.29	69.93	113.22	21.31	15.84
		6	6685	149.28	52.06	81.68	133.74	15.54	10.41
	AVERAGE		6001	140.46	46.31	74.76	120.97	19.50	14.03
7	Alfalfa hay	1	6888	234.16	76.90	161.77	238.67	4.51	
		2	7155	240.62	74.53	148.20	222.73	17.89	7.43
		3	7264	243.25	79.36	162.98	242.34	0.91	0.37
		4	6981	236.41	72.01	152.68	224.69	11.72	4.96
		5	7694	253.66	78.92	141.91	220.83	32.83	12.94
		6	8915	296.69	92.77	160.09	252.86	43.83	14.77
	AVERAGE		7483	250.80	79.08	154.61	233.69	17.11	

		10	6945	128.61	41.11	64.71	114.83	13.82	7.98
		11	5631	115.13	42.70	71.73	114.43	0.70	0.61
		12	6249	121.50	46.92	69.32	116.24	5.26	4.33
	AVERAGE		5930	118.22	43.45	64.95	108.40	9.81	8.37
5	Merker grass (after blooming)	1	6445	146.19	49.07	80.87	129.94	16.25	11.12
		2	5438	133.20	38.81	66.69	105.50	27.70	20.80
		3	5897	139.12	48.31	74.13	122.44	16.68	11.99
		5	5541	134.53	43.29	69.93	113.22	21.31	15.84
		6	6685	149.28	52.06	81.68	133.74	15.54	10.41
	AVERAGE		6001	140.46	46.31	74.76	120.97	19.50	14.03
7	Alfalfa hay	1	6888	234.16	76.90	161.77	238.67	4.51	
		2	7155	240.62	74.53	148.20	222.73	17.89	7.43
		3	7264	243.25	79.36	162.98	242.34	0.91	0.37
		4	6981	236.41	72.01	152.68	224.69	11.72	4.96
		5	7694	253.66	78.92	141.91	220.83	32.83	12.94
		6	8915	296.69	92.77	160.09	252.86	43.83	14.77
	AVERAGE		7483	250.80	79.08	154.61	233.69	17.11	
8	Alfalfa hay	7	7040	266.38	78.22	139.15	217.37	49.01	18.40
		8	8246	293.52	92.64	147.66	240.30	53.22	18.13
		9	8519	320.20	78.91	181.09	260.00	60.20	18.80
		10	9530	342.95	104.83	191.24	296.07	46.88	13.67
		11	10355	361.51	112.15	195.39	307.54	53.97	14.93
		12	9995	353.41	108.49	181.93	290.42	62.99	17.82
	AVERAGE		8948	323.00	95.87	172.74	268.62	54.38	16.96
9	Alfalfa hay	1	8754	311.19	95.25	178.80	274.05	37.14	11.93
		2	8131	299.10	87.62	161.69	249.31	49.79	16.65
		3	8623	308.64	88.76	165.12	253.88	54.76	17.74
		4	7939	295.37	86.52	178.11	264.63	30.74	10.41
		5	8820	312.47	91.27	153.64	244.91	67.56	21.62
		6	10909	352.99	111.85	199.19	311.04	41.95	11.88
	AVERAGE		8863	313.29	93.55	172.76	266.30	46.99	15.04
10	Merker grass (after blooming)	7	6508	127.81	40.59	67.99	117.58	10.23	8.00
		8	6887	130.95	44.86	69.64	114.50	16.45	12.56
		9	8307	157.49	48.89	72.86	121.75	35.74	22.69
		10	8219	156.76	52.58	89.57	142.15	14.61	9.32
		13	6952	131.49	42.57	72.20	114.77	16.72	12.72
		14	6925	131.27	47.68	72.80	120.48	10.79	8.22
	AVERAGE		7300	139.30	46.20	74.18	121.87	17.42	12.25

10	Merker grass (after blooming)	9	8307	157.49	48.89	72.86	121.75	35.74	22.69
		10	8219	156.76	52.58	89.57	142.15	14.61	9.32
		12	6952	131.49	42.57	72.20	114.77	16.72	12.72
		14	6925	131.27	47.68	72.80	120.48	10.79	8.22
	AVERAGE		7300	139.30	46.20	74.18	121.87	17.42	12.25
11	2/3 Merker grass + 1/3 pigeon peas(in flower)	1	6830	200.67	70.02	102.14	172.16	28.51	14.21
		2	6249	193.81	65.25	87.47	152.72	41.09	21.20
		3	7188	204.89	79.26	98.05	177.31	27.58	13.46
		4	6517	196.97	64.71	105.84	170.55	26.42	13.41
		5	6813	200.46	75.40	98.00	173.40	27.06	13.50
		6	9029	247.62	91.03	118.54	209.57	38.05	15.37
	AVERAGE		7104	207.40	74.28	101.67	175.95	31.45	15.19
12	2/3 Para grass + 1/3 pigeon peas (in flower)	7	7102	174.34	62.33	69.65	131.98	42.36	24.30
		8	6117	163.90	67.60	79.93	147.53	16.37	9.99
		9	8557	212.05	80.84	98.04	178.88	33.17	15.64
		10	8267	211.45	78.95	98.77	177.72	33.73	15.95
		13	7631	204.71	75.79	101.20	176.99	27.72	13.54
		14	7857	207.10	76.13	96.75	172.88	34.22	16.52
	AVERAGE		7589	195.59	73.61	90.72	164.33	31.26	15.99
13	Para grass (after blooming)	1	6262	96.54	39.90	56.30	96.20	0.34	0.35
		2	6237	96.28	36.88	50.91	87.79	8.49	8.82
		3	7271	112.53	48.08	57.29	105.37	7.16	6.36
		4	6964	111.69	38.76	58.70	97.46	14.23	12.74
		5	7391	116.13	44.26	62.10	106.36	9.77	8.41
		6	7746	119.82	48.53	60.65	109.18	10.64	8.88
	AVERAGE		6979	108.83	42.74	57.66	100.39	8.44	7.59
14	Para grass (after blooming)	7	6003	142.42	38.98	67.80	106.78	35.64	25.02
		8	5807	128.34	45.93	68.13	114.06	14.28	11.13
		9	7763	165.01	54.22	77.07	131.29	33.72	20.44
		10	8593	182.79	57.34	91.40	148.74	34.05	18.63
		13	7527	162.18	52.82	80.45	133.27	28.91	17.83
		14	8010	167.97	53.37	80.85	134.22	33.75	20.09
	AVERAGE		7284	158.12	50.44	77.62	128.06	30.06	18.86

TABLE 16

SUMMARY OF THE NUTRITIVE INDEXES DETERMINED
IN THE EXPERIMENTS PERFORMED DURING THE YEAR 1938-39

Ration	Dates on which trials were performed	Coefficient of apparent digestibility						Biological value of protein	Net protein value	Nutritive ratio	Ca/P ratio
		Dry matter	Crude protein	Crude fat	Crude fiber	N-free extract	Organic matter				
Cow peas (starting blooming)	Oct. 1 to Oct. 11, 1938	61	77	63	56	75	70	33	0.531	3.48	9.53
Cow peas (full-blooming stage)	Oct. 12 to Oct. 22, 1938	62	79	66	54	74	71	40	0.776	2.94	10.82
Cow peas (in full pods)	Oct. 22 to Nov. 2, 1938	67	76	60	45	81	71	47	0.804	4.76	3.20
Merker grass (after blooming)	Nov. 11 to Dec. 2, 1938	55	66	57	61	58	60	48	0.679	7.98	1.76
Yaraguá grass (N only)	Dec. 16 to Dec. 26, 1938	49	18	37	56	55	53	83	0.149	87.90	2.59
Alfalfa hay (partly dry)	Dec. 27 to Jan. 28, 1939	58	70	25	53	60	59	36	3.81	3.24	5.44
2/3 Merker grass + 1/3 pigeon	Feb. 9 to Feb. 19, 1939	53	64	67	24	64	56	45	0.860	4.57	2.12

Cow peas (in full pods)	Oct. 22 to Nov. 2, 1938	55	66	57	61	58	60	48	0.679	1.98	1.16
Merker grass (after blooming)	Nov. 11 to Dec. 2, 1938	49	18	37	56	55	53	83	0.149	87.90	2.59
Yaraguá grass (N only)	Dec. 16 to Dec. 26, 1938	58	70	25	53	60	59	36	3.81	3.24	5.44
Alfalfa hay (partly dry)	Dec. 27 to Jan. 28, 1939	53	64	67	24	64	56	45	0.860	4.57	2.12
2/3 Merker grass + 1/3 pigeon peas (in bloom)	Feb. 9 to Feb. 19, 1939	51	62	49	41	60	55	49	0.779	5.77	1.87
2/3 Para grass + 1/3 pigeon peas (in bloom)	Feb. 20 to March 2, 1939	56	65	51	57	61	60	53	0.649	8.04	1.36
Para grass (after blooming)	March 3 to March 24, 1939										
Low-protein ration	May 6 to June 18, 1939	Fecal nitrogen per gram of dry matter ingested = 0.00418						Urinary nitrogen per kgm. of body weight = 0.545			

TABLE 17

VITAMIN A ACTIVITIES OF GRASSES AND LEGUMES
(SHERMAN UNITS)

	Vitamin A unit per gram
"Yaraguá" grass, whole, air-dried	33
Merker grass, whole, air-dried	50
Alfalfa hay, whole, air-dried*	10
Cow peas, pod stage, whole, air-dried	58
Cow peas, flower stage, whole, air-dried	200
Velvet beans, flower stage, whole, air-dried	200
Soy beans, flower stage, whole, air-dried	200
Soy beans, pod stage, whole, air-dried	100

* Dried in the field. All others were dried in the laboratory.

CHEMICAL ANALYSES OF GRASSES[1]

By *Joseph H. Axtmayer, G. Rivera Hernández* and *D. H. Cook* with the technical assistance of *José A. Goyco* and *M. C. de Fernández*[2]

From the Department of Chemistry of the School of Tropical Medicine, San Juan, Puerto Rico and the Department of Chemistry of the Agricultural Experiment Station, Río Piedras, Puerto Rico.

The object of this study was to find through the medium of a systematic survey, grasses which would be worthwhile a trial in our studies of the nutritive values of forage crops of Puerto Rico. Although the findings from a chemical analysis of a grass do not yield all the data necessary for judging its nutritive value, nevertheless, some light is shed upon its possibilities. Grasses of good nutritive qualities with root systems capable of reducing soil erosion would be of double value to the agricultural economics of the Island.

Puerto Rico imports large quantities of mixed feed concentrates used by the dairy industry. Even so, the milk production is insufficient to meet the needs of the inhabitants of the Island, were each individual to receive the daily amount considered adequate by our present knowledge of optimum nutritional requirements. It is also expensive, considering the income of the lower class of people. We see no reason why uncultivated regions could not be used to produce crops which could be used as forage, not only for grazing, but for cutting and mixing with other crops in the preparation of concentrates.

MATERIALS

All the grasses analyzed had been cut during the blooming stage with the exception of sample 64, same grass as sample 63,

1 Cooperative project between the School of Tropical Medicine and the Agricultural Experiment Station.

2 Mr. G. L. Crawford, Chief, Soil Conservation Service in Puerto Rico, and Dr. H. W. Alberts cooperated by furnishing samples of varieties and species and also valuable agronomic data.

which was cut during the after-blooming stage. Our reason for collecting the grasses for analysis during the blooming stage was to obtain comparable samples. Although it is known that an actively growing unmature grass, contains more protein and more total digestible nutrients than the more mature plants, the flowering stage was selected for the sake of uniformity.

METHODS OF ANALYSIS

The samples were brought to the laboratory as soon as cut. They were then cleaned, cut into smaller sizes, weighed and placed in a large horizontal flow, forced-air oven for the moisture determinations. When dry, they were ground in a Wiley mill, and the powder stored in air-tight bottles for the determinations of the other constituents. The analyses were performed according to the methods of the Official Agricultural Chemists. All analyses for a given constituent were performed in duplicate.

DISCUSSION

The analyses of the grasses as reported on the dry basis show that some are quite rich in total crude protein, and would yield a hay of some nutritional value. Those yielding a percentage of protein above ten (10) could be used for this purpose.

They are low in ether-soluble extract (fat) and high in crude fiber, as is to be expected. The nitrogen-free extract (carbohydrates) averages around 45-50% and is a good source of energy.

The most favorable ratio of calcium to phosphorus for growth and bone formation is between 2 and 1 and 1 and 2. With the amount of ultraviolet radiation available throughout the year in the sunshine of Puerto Rico, an abundance of vitamin D for the mobilization of the calcium and phosphorus is assured. The calcium and phosphorus ratios of the grasses studied are all narrow and within the limits of profitable utilization.

Abundance of all the other vitamins is also a certainty in the fresh grasses but may be reduced when these are dried.

Nutritional studies which have been planned include some of these grasses, to be used either fresh, as cut, or as hay, in the experimental rations. The formulation of a cheap ration, nutritionally adequate, consisting of crops grown in Puerto Rico would be of great help in the production of cheap milk which is of such great importance in human dietaries.

SUMMARY

Chemical analyses of eighty-three grasses, calculated on the wet and dry basis, are reported. Their composition is discussed from a nutritional point of view.

Scientific, English and Spanish common names of the grasses are also given.

SUMMARY

Chemical analyses of eighty-three grasses, calculated on th wet and dry basis, are reported. Their composition is discusse from a nutritional point of view.

Scientific, English and Spanish common names of the grass are also given.

TABLE 1

SCIENTIFIC AND COMMON NAMES OF GRASSES

TABLE 1

SCIENTIFIC AND COMMON NAMES OF GRASSES ANALYZED[9]

Ref. No.	Scientific Name	English Common Name	Spanish Common Name
1	*Andropogon annulatus* Forsk	Railroad grass[1]	
2	" *bicornis* L.	Fox-tail grass, ridging grass	Rabo de gato[3]
3	" *brevifolius* Swartz	Beardgrass	Colchón[1], matojillo[3]
4	*Anthephora hermaphrodita* (L.) Kuntze		
5	*Arundinella confinis* (Schult.) Hitchc. and Chase	Rat-tail	Rabo de ardilla[1]
6	*Axonopus compressus* (Swartz) Beauv.	Carpet grass, flat-joint grass	Pasto de alfombra[1]
7	*Brachinaria subquadripara*	East Indies grass[1]	
8	*Cenchrus pauciflorus* Benth.	Field sandbur, bur grass[2]	Abrojo
9	*Chloris gayana* Kunth	Rhodes grass	Yerba de Rodes[5]
10	" *inflata* Link	Short-finger grass	Horquetilla morada[1]
11	" *petraea* Swartz	Finger grass	Yerba de deo[2]
12	" *radiata* (L.) Swartz	Plush grass	Horquetilla[3], grama de costa[1]
13	*Cymbopogon citratus*	Lemon grass	Yerba limón, limoncillo
14	*Cynodon dactylon* (L.) Pers.	Bermuda grass	Yerba Bermuda, grama, hierba fina, Pepe Ortiz[2]
15	" *plectostachyum*	Giant Bermuda[1]	Bermuda gigante[1]
16	*Coix Lacryma* Jobi, L.	Job's tears, Christ's tears	Camándulas, lágrimas de Job
17	*Dactylotenium aegyptium* (L.) Richt.	Crowfoot grass, Egyptian grass[3]	Yerba egipcia[2]
18	*Digitaria horizontalis* Willd.	This genus is known collectively as crab or finger grass[5]	Pendejuelo*
19	" *sanguinalis* L.	Crabgrass	Yerba de cangrejo[2]
20	*Echinochloa colonum* (L.) Link	Jungle rice	Arroz del monte
21	" *polystachya* (H. B. K.) Hitchc.	River grass[2]	Yerba de río[2]
22	*Eleusine indica* L.	Goosegrass, wire grass[3]	Pata de gallina, piepul, yerba dulce
23	*Eragrostis ciliaris* (L.) Link	Lovegrass	Yerba de amor, ilusión
24	*Eriochloa polystachya* H. B. K.	Malojilla grass	Malojilla[1]
25	" *punctata* (L.) Desv.	Cupgrass	
26	*Gynerium sagittatum* (Aubl.) Beauv.	Wild cane, uva grass[3]	Caña cimarrona[2], caña de la India[3], caña brava[2]
27	*Hymenachne amplexicaulis* (Rudge) Nees.		Trompetilla[2]
28	*Ichnanthus pallens* (Swartz.) Munro.		Carruzo
29	*Ixosphorus unisetus* (Presl.) Schlecht.	Hatico grass	Yerba de Méjico
30	*Lasiacis divaricata* (L.), Hitchc.	Cane grass[3]	Yerba de caña, pito de bejuco
31	" *ruscifolia* (H. B. K.) Hitchc.		Pito de alfombra
32	*Leersia hexandra*, Swartz.	Rice grass*	
33	*Leptochloa filiformis* (Lam.) Beauv.	Red sprangleton. Arrow grass[5]	
34	" *scabra*. Nees.	River sprangletop[1]	
35	*Lithachne pauciflora* (Swartz) Beauv.		Yerba de la sombra[1]
36	*Melinis minutiflora* Beauv.	Molasses grass	Yerba de melado[2], pasto o zacate gordura, Yaraguá
37	" " "	Molasses grass	Yerba de melado[2], pasto o zacate gordura, Yaraguá
38	*Oriza sativa*, L.	Rice	Arroz
39	*Panicum acuminatum* Swartz.		Yerba de ramillete[1]
40	" *adspersum* Trim.		Arrocillo*
41	" *aquaticum* Poir.	Aquatic grass	Yerba acuática
42	" *fasciculatum* Swartz.	Browntop millet	
43	" *geminatum* Forsk.	Water grass[3]	Yerba de agua
44	" *laxum* Swartz.		Malojillo del monte
45	" *maximum*, Jacq.	Guinea grass	Yerba de Guinea
46	" *maximum* var. Borinquen	Borinquen grass[1]	Yerba de Borinquen

		rice grass*	
33	*Leptochloa filiformis* (Lam.) Beauv.	Red sprangletop. Arrow grass[5]	
34	" *scabra*. Nees.	River sprangletop[1]	
35	*Lithachne pauciflora* (Swartz) Beauv.		Yerba de la sombra[1]
36	*Melinis minutiflora* Beauv.	Molasses grass	Yerba de melado[2], pasto o zacate gordura, Yaraguá
37	" " "	Molasses grass	Yerba de melado[2], pasto o zacate gordura, Yaraguá
38	*Oriza sativa*. L.	Rice	Arroz
39	*Panicum acuminatum* Swartz.		Yerba de ramillete[1]
40	" *adspersum* Trim.		Arrocillo*
41	" *aquaticum* Poir.	Aquatic grass	Yerba acuática
42	" *fasciculatum* Swartz.	Browntop millet	
43	" *geminatum* Forsk.	Water grass[3]	Yerba de agua
44	" *laxum* Swartz.		Malojillo del monte
45	" *maximum*. Jacq.	Guinea grass	Yerba de Guinea
46	" *maximum* var. Borinquen	Borinquen grass[1]	Yerba de Borinquen
47	" " " Gramalote	A variety of Guinea grass[5]	Gramalote[1]
48	" *purpuracens* Raddi.	Para grass	Malojillo
49	" *trichanthum* Nees.		Carrucillo[1], ilusión[1]
50	*Paspalum conjugatum* Bergius.	Sour paspalum, sour grass, sour grama[1]	Grama amarga, cintillo[2], horquetilla blanca[1]
51	" *decumbens* Swartz.		Pendejuelo*
52	" *distichum* L.	Knotgrass, joint grass[3]	Salaillo[1]
53	" *fimbriatum* H. B. K.	Panama paspalum	
54	" *laxum* Lam.		Matojo de la arena[1]
55	" *millegrana* Schrad.		Cortadera[1]
56	" *notatum* Flugge.	Bahia grass	Yerba de Bahía[5]
57	" *paniculatum* L.	Hairy grass	Gramilla[2], arrocillo[2], yerba peluda[1]
58	" *plicatulum* Michx.	Sweet grass[1]	Yerba dulce[1]
59	" *virgatum* L.		Cortadero, matojo blanco[1]
60	*Pennisetum glaucum* L.	Pearl millet	Rabo de gato*
61	" *oxidentalis*	Ecuador grass	Yerba de Ecuador
62	" *purpureum* Schum.	Elephant grass, Napier grass[3]	Yerba elefante
63	" " var. Merker.	Merker grass	Yerba Merker
64	" " var. Merker (after blooming)	Merker grass	Yerba Merker
65	" " var. Napier	Imported Napier grass*	Yerba Napier[5]
66	*Polytrias amaura**	Java grass	Yerba de Java
67	*Saccharum spontaneum**	Indian wild sugar cane[5]	Caña de azúcar silvestre[5]
68	*Sacciolepis striata* (L.) Nash.	Swamp grass[1]	Yerba de pantano[1]
69	*Setaria barbata* (Lam.) Kunth.	Mary grass	

		blooming)	
65	" " var. Napier	Merker grass	Yerba Merker
66	*Polytrias amaura**	Imported Napier grass*	Yerba Napier[5]
67	*Saccharum spontaneum**	Java grass	Yerba de Java
68	*Sacciolepis striata* (L.) Nash.	Indian wild sugar cane[5]	Caña de azúcar silvestre[5]
69	*Setaria barbata* (Lam.) Kunth.	Swamp grass[1]	Yerba de pantano[1]
70	" *geniculata* (Lam.) Beauv.	Mary grass	
71	" *vulpiseta* (Lam.) Roem. and Schutt.	Knotroot bristlegrass	Cepillo de diente[1]
72	*Sorghastrum setosum* (Griseb.) Hitchc.	Squirrel-tail-grass	Rabo de ardilla[1]
73	*Sorghum vulgare* (L.) Pers.	Sorghum or sorgo, Guinea corn	Millo, sorgo
74	" " var. sudanensis (Piper), Hitchc.	Sudan grass	Yerba de Sudán
75	*Sporobolus indicus* L.	West Indian rush grass	Matojo[2], cerrillo[2]
76	" *poiretti* (Roem and Schult.) Hitchc.	Smutgrass	Matojo de burro[1], rabo de mula[1]
77	*Stenotaphrum secundatum* (Walt.) Kuntze	St. Augustine grass, running-crab grass	Cinta[2], gramón de costa[3], grama blanca[3]
78	*Trichachne insularis* (L.) Nees.	Sour grass	Zorra de limón[3], rabo de zorra[3], barba de indio[3]
79	*Tricholaena repens* (Willd.) Hitchc.	Natal grass	Yerba de Natal
80	*Tripsacum laxum* Nash.	Guatemala grass	Yerba Guatemala
81	Unknown	Hato Rey grass	Yerba Hato Rey
82	*Vetiveria zizanioides* Nash.	Vetiver grass Khus-khus	Patcholí, pacholí
83	*Zea Mays* L.	Indian corn	Maíz

9 The grasses were obtained from the Agricultural Experiment Station of the University of Puerto Rico through the courtesy of the Soil Conservation Service.

* Common name doubtful.

1 "Observations on Possible Erosion Control Grasses of P. R." By O. García Molinari. Soil Conservation, U. S. Department of Agriculture, Vol. IV, No. 11, p. 267, May 1939.

2 "Catálogo de los Nombres Vulgares y Científicos de Algunas Plantas Puertorriqueñas". By José I. Otero y R. A. Toro, Insular Expt. Sta. Bul. 37, 1931.

3 "Scientific Survey of Porto Rico and the Virgin Islands". Vol. V. New York Academy of Science, 1924.

4 Names without reference number were taken from: "Manual of the Grasses of the West Indies". By A. S. Hitchcock, U. S. Department of Agriculture, Washington, D. C.

5 Names given by Mr. José I. Otero, Librarian, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.

TABLE 1

ANALYSES OF THE GRASSES OF PUERTO RICO

Wet basis

Grass No.	Total moisture	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Nitrogen-free extract	Ash	Calcium	Phosphorus
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
1	66.99	1.79	0.59	11.15	16.01	3.47	0.1564	0.0453
2	73.31	1.60	0.40	10.36	12.37	1.96	0.0302	0.0268
3	78.50	1.17	0.41	7.65	10.46	1.81	0.0528	0.0173
4	82.71	1.96	0.27	4.93	6.30	3.83	0.0429	0.0285
5	69.75	1.38	0.54	11.44	14.39	2.50	0.0433	0.0188
6	82.60	2.21	0.33	5.12	7.58	2.06	0.0536	0.0355
7	83.04	2.08	0.64	4.77	7.11	2.36	0.0507	0.0246
8	78.44	3.03	0.77	6.07	9.26	2.43	0.0388	0.0429
9	79.10	2.17	0.93	7.01	9.13	1.66	0.0665	0.0297
10	72.08	2.39	0.66	9.74	12.39	2.74	0.0951	0.0368
11	76.23	2.44	0.59	7.38	10.74	2.62	0.0528	0.0368
12	71.24	3.49	0.65	8.86	13.38	2.38	0.0657	0.0399
13	79.25	1.35	0.91	5.92	11.24	1.33	0.0552	0.0191
14	76.23	3.42	0.81	6.49	10.81	2.24	0.1080	0.0853
15	79.73	2.55	0.42	6.79	8.66	1.85	0.0561	0.0312
16	79.12	2.04	0.85	6.58	9.00	2.41	0.1380	0.0378
17	77.35	1.77	0.49	6.89	11.22	2.28	0.0819	0.0361
18	82.28	2.34	0.43	5.35	7.63	1.97	0.0490	0.0432
19	76.86	2.95	0.64	6.66	9.92	2.97	0.0652	0.0494
20	82.61	2.21	0.42	5.24	7.03	2.49	0.0851	0.0385
21	82.50	2.47	0.42	5.21	7.42	1.98	0.0679	0.0341
22	72.72	2.76	0.90	8.58	12.93	2.11	0.1240	0.0396
23	70.18	1.81	0.68	9.57	15.29	2.47	0.0924	0.0155
24	72.68	1.43	0.80	9.50	12.84	1.75	0.0348	0.0202

18	82.28	2.91	0.64	6.66	9.92	2.97	0.0851	0.0385
19	76.86	2.95	0.42	5.24	7.03	2.49	0.0679	0.0341
20	82.61	2.21	0.42	5.21	7.42	1.98	0.1240	0.0396
21	82.50	2.47	0.90	8.58	12.93	2.11	0.0924	0.0155
22	72.72	2.76	0.68	9.57	15.29	2.47	0.0348	0.0202
23	70.18	1.81	0.80	9.50	13.84	1.75	0.0482	0.0440
24	72.68	1.43	0.45	4.98	7.03	2.20	0.1580	0.0357
25	83.15	2.19	0.48	10.72	11.32	5.00	0.0391	0.0611
26	69.24	3.24	0.46	7.66	9.54	1.70	0.0465	0.0294
27	78.32	2.32	0.46	5.53	6.77	2.50	0.0458	0.0197
28	82.43	2.31	0.44	3.82	5.70	1.21	0.0469	0.0247
29	87.38	1.45	0.64	13.07	13.08	3.68	0.0779	0.0313
30	66.26	3.27	0.73	10.25	11.35	3.45	0.0904	0.0655
31	71.05	3.17	0.64	7.61	9.18	4.43	0.1630	0.0702
32	74.41	3.73	0.42	5.55	7.70	4.01	0.0610	0.0445
33	79.63	2.69	0.52	5.69	8.04	2.13	0.1200	0.0472
34	81.48	2.14	1.07	11.46	14.34	7.24	0.0648	0.0301
35	61.94	3.95	0.90	9.19	11.33	1.46	0.1010	0.0705
36	75.56	1.56	1.06	13.63	16.97	2.44	0.0406	0.0451
37	64.73	1.17	0.59	5.45	7.70	2.29	0.1007	0.0476
38	80.48	3.49	1.04	8.68	13.76	7.42	0.0975	0.1340
39	65.67	3.43	0.61	5.51	9.14	5.64	0.0292	0.0302
40	76.97	2.13	0.56	4.28	7.28	1.42	0.1223	0.0490
41	84.71	1.75	0.50	6.04	9.69	2.64	0.0286	0.0213
42	79.05	2.08	0.37	6.01	8.07	2.78	0.0359	0.0242
43	80.82	1.95	0.60	6.09	9.09	2.89	0.0582	0.0162
44	79.01	2.32	0.71	11.50	11.94	2.24	0.0681	0.0412
45	72.44	1.17	0.60	9.34	9.29	2.49	0.0706	0.0297
46	75.60	2.68	0.53	11.09	11.99	2.17	0.0678	0.0204
47	72.05	2.17	0.54	7.59	11.04	1.76	0.0578	0.0246
48	77.37	1.70	0.68	5.63	6.64	3.06	0.0539	0.0241
49	81.35	2.64	0.56	7.22	10.03	1.73	0.0439	0.0306
50	78.32	2.14	0.42	5.82	8.33	3.16	0.0512	0.0334
51	80.14	2.13	0.93	7.91	10.71	1.78	0.2445	0.0348
52	76.42	2.25	0.37	4.60	6.89	1.82	0.1123	0.0282
53	85.01	1.31						

25	83.15	2.19	0.45	4.98	7.03	2.20	0.0482	0.0440
26	69.24	3.24	0.48	10.72	11.32	5.00	0.1580	0.0357
27	78.32	2.32	0.46	7.66	9.54	1.70	0.0391	0.0611
28	82.43	2.31	0.46	5.53	6.77	2.50	0.0465	0.0294
29	87.38	1.45	0.44	3.82	5.70	1.21	0.0458	0.0197
30	66.26	3.27	0.64	13.07	13.08	3.68	0.0469	0.0247
31	71.05	3.17	0.73	10.25	11.35	3.45	0.0779	0.0313
32	74.41	3.73	0.64	7.61	9.18	4.43	0.0904	0.0655
33	79.63	2.69	0.42	5.55	7.70	4.01	0.1630	0.0702
34	81.48	2.14	0.52	5.69	8.04	2.13	0.0610	0.0445
35	61.94	3.95	1.07	11.46	14.34	7.24	0.1200	0.0472
36	75.56	1.56	0.90	9.19	11.33	1.46	0.0648	0.0301
37	64.73	1.17	1.06	13.63	16.97	2.44	0.1010	0.0705
38	80.48	3.49	0.59	5.45	7.70	2.29	0.0406	0.0451
39	65.67	3.43	1.04	8.68	13.76	7.42	0.1007	0.0476
40	76.97	2.13	0.61	5.51	9.14	5.64	0.0975	0.1340
41	84.71	1.75	0.56	4.28	7.28	1.42	0.0292	0.0302
42	79.05	2.08	0.50	6.04	9.69	2.64	0.1223	0.0490
43	80.82	1.95	0.37	6.01	8.07	2.78	0.0286	0.0213
44	79.01	2.32	0.60	6.09	9.09	2.89	0.0359	0.0242
45	72.44	1.17	0.71	11.50	11.94	2.24	0.0582	0.0162
46	75.60	2.68	0.60	9.34	9.29	2.49	0.0681	0.0412
47	72.05	2.17	0.53	11.09	11.99	2.17	0.0706	0.0297
48	77.37	1.70	0.54	7.59	11.04	1.76	0.0678	0.0204
49	81.35	2.64	0.68	5.63	6.64	3.06	0.0578	0.0246
50	78.32	2.14	0.56	7.22	10.03	1.73	0.0539	0.0241
51	80.14	2.13	0.42	5.82	8.33	3.16	0.0439	0.0306
52	76.42	2.25	0.93	7.91	10.71	1.78	0.0512	0.0334
53	85.01	1.31	0.37	4.60	6.89	1.82	0.2445	0.0348
54	72.69	2.85	0.57	8.49	11.61	3.79	0.1133	0.0292
55	76.67	1.43	0.63	8.54	11.15	1.58	0.0285	0.0203
56	75.60	2.41	0.64	7.07	11.23	3.05	0.0402	0.0329
57	79.95	1.27	0.65	7.07	9.00	2.06	0.0776	0.0580
58	77.48	2.21	0.47	6.34	10.29	3.21	0.0961	0.0240
59	77.43	1.39	0.68	7.80	11.08	1.62	0.0242	0.0201
60	80.86	2.67	0.49	6.31	7.91	1.76	0.0404	0.0220
61	84.77	1.87						

56	75.60	2.41	0.64	7.07	11.23	3.05	0.0402	0.0329
57	79.95	1.27	0.65	7.07	9.00	2.06	0.0776	0.0580
58	77.48	2.21	0.47	6.34	10.29	3.21	0.0961	0.0240
59	77.43	1.39	0.68	7.80	11.08	1.62	0.0242	0.0201
60	80.86	2.67	0.49	6.31	7.91	1.76	0.0404	0.0339
61	84.77	1.87	0.53	4.72	6.77	1.34	0.0522	0.0218
62	74.00	3.06	0.96	8.73	11.20	2.05	0.0504	0.0394
63	73.06	3.32	1.13	9.59	10.69	2.21	0.0692	0.0378
64	76.17	2.06	0.74	8.60	10.00	2.43	0.0805	0.0486
65	77.79	2.65	0.51	7.96	9.39	1.70	0.0443	0.0378
66	83.42	1.87	0.48	5.13	7.45	1.65	0.0491	0.0363
67	68.18	1.28	0.67	12.78	15.16	1.93	0.0545	0.0329
68	85.41	2.03	0.41	3.79	5.95	2.41	0.0325	0.0251
69	81.64	2.40	0.62	5.59	8.09	1.66	0.0327	0.0316
70	73.68	1.97	0.64	8.59	11.22	3.90	0.0839	0.0284
71	80.68	2.15	0.63	6.75	7.73	2.06	0.0535	0.0510
72	68.42	1.82	0.51	12.37	14.63	2.25	0.0369	0.0269
73	77.30	2.03	0.83	6.91	11.04	1.89	0.0506	0.0651
74	73.80	2.83	1.03	8.11	11.39	2.84	0.1960	0.0781
75	65.16	1.66	0.57	12.99	16.85	2.77	0.1584	0.0787
76	67.31	3.29	0.91	11.69	14.16	2.64	0.0687	0.0451
77	83.20	2.26	0.36	4.46	6.53	3.19	0.0534	0.0298
78	82.60	2.10	0.44	6.15	6.83	1.88	0.0559	0.0268
79	76.00	2.10	0.74	9.89	9.69	1.58	0.0521	0.0214
80	81.66	1.94	0.42	6.84	8.09	1.41	0.0288	0.0266
81	84.12	1.73	0.46	3.98	6.50	3.21	0.0359	0.0221
82	68.16	1.47	0.57	13.25	14.84	1.71	0.0402	0.0238
83	83.07	1.97	0.48	4.81	8.51	1.16	0.0262	0.0344

TABLE 3

ANALYSES OF THE GRASSES OF PUERTO RICO

Dry basis

Grass No.	Total solids	Crude protein (N x 6.25)	Ether-soluble extract	Crude fiber	Nitrogen-free extract	Ash	Calcium	Phosphorus	Ca:P ratio
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
1	33.01	5.44	1.80	33.79	48.46	10.51	0.476	0.138	3.45
2	26.69	6.00	1.50	38.83	46.31	7.36	0.113	0.1004	1.13
3	21.50	5.42	1.93	35.60	48.64	8.41	0.246	0.0808	3.04
4	17.29	11.31	1.59	28.50	36.44	22.16	0.248	0.165	1.50
5	30.25	4.55	1.80	37.83	47.54	8.28	0.143	0.0621	2.30
6	17.40	12.69	1.91	29.42	43.57	12.41	0.306	0.203	1.51
7	16.96	12.25	3.78	28.10	41.95	13.92	0.299	0.145	2.06
8	21.56	14.06	3.56	28.13	43.00	11.25	0.199	0.180	1.11
9	20.90	10.38	4.43	33.55	43.69	7.95	0.318	0.142	2.24
10	27.92	8.56	2.35	34.90	44.36	9.83	0.341	0.132	2.58
11	23.77	10.25	2.47	31.06	45.20	11.02	0.222	0.155	1.43
12	28.76	12.13	2.27	30.80	46.54	8.26	0.229	0.139	1.65
13	20.75	6.50	4.38	28.55	54.15	6.42	0.265	0.0918	2.89
14	23.77	14.38	3.40	27.29	45.51	9.42	0.456	0.312	1.46
15	20.27	12.56	2.07	33.52	42.71	9.14	0.277	0.154	1.80
16	20.88	9.75	4.06	31.51	43.15	11.53	0.662	0.181	3.66
17	22.65	7.81	2.17	30.42	49.52	10.08	0.363	0.160	2.27
18	17.72	13.19	2.43	30.17	43.20	11.01	0.277	0.244	1.14
19	23.14	12.75	2.75	28.76	42.89	12.85	0.281	0.213	1.32
20	17.39	12.69	2.44	30.14	40.30				
21	17.50								

16	20.88	9.75	4.06	33.52	42.71	9.14	0.277	0.154	1.80
17	22.65	7.81	2.17	31.51	43.15	11.53	0.662	0.181	3.66
18	17.72	13.19	2.43	30.42	49.52	10.08	0.363	0.160	2.27
19	23.14	12.75	2.75	30.17	43.20	11.01	0.277	0.244	1.14
20	17.39	12.69	2.44	28.76	42.89	12.85	0.281	0.213	1.32
21	17.50	14.13	2.40	30.14	40.39	14.34	0.489	0.221	2.21
22	27.28	10.13	3.30	29.78	42.37	11.32	0.305	0.195	1.56
23	29.82	6.08	2.28	31.44	47.41	7.72	0.454	0.145	3.13
24	27.32	5.25	2.93	32.09	51.26	8.29	0.307	0.0523	5.87
25	16.85	13.00	2.67	34.76	50.65	6.41	0.128	0.0742	1.73
26	30.76	10.51	1.57	29.54	41.73	13.06	0.287	0.262	1.11
27	21.68	10.69	2.14	34.86	36.79	16.27	0.513	0.116	4.42
28	17.57	13.13	2.60	35.31	44.02	7.84	0.182	0.284	0.64
29	12.62	11.50	3.48	31.48	38.54	14.25	0.264	0.167	1.58
30	33.74	9.69	1.89	30.30	45.15	9.57	0.365	0.157	2.32
31	28.95	10.94	2.52	38.74	38.76	10.92	0.139	0.0732	1.90
32	25.59	14.56	2.51	35.41	39.21	11.92	0.269	0.108	2.49
33	20.37	13.19	2.06	29.74	35.88	17.31	0.353	0.256	1.38
34	18.52	11.56	2.82	27.23	37.84	19.68	0.800	0.344	2.33
35	38.06	10.38	2.80	30.71	43.50	11.41	0.329	0.240	1.37
36	24.44	6.38	3.31	30.10	37.71	19.01	0.314	0.124	2.53
37	35.27	3.31	3.01	37.62	46.70	5.99	0.265	0.123	2.15
38	19.52	17.88	3.04	38.64	48.11	6.93	0.287	0.200	1.44
39	34.33	10.00	3.02	27.93	39.41	11.74	0.208	0.231	0.90
40	23.03	9.25	2.63	25.28	40.08	21.62	0.294	0.139	2.12
41	15.29	11.44	3.62	23.94	39.68	24.50	0.424	0.583	0.727
42	20.95	9.94	2.37	27.98	47.68	9.28	0.190	0.127	1.50
43	19.18	10.19	1.91	28.81	46.35	12.53	0.585	0.239	2.44
44	20.99	11.06	2.86	31.32	42.10	14.48	0.149	0.111	1.34
45	27.56	4.26	2.57	29.01	43.32	13.75	0.171	0.115	1.49
46	24.40	11.00	2.47	41.74	43.31	8.12	0.212	0.0591	3.59
47	27.95	7.75	1.91	38.27	38.05	10.21	0.277	0.168	1.65
48	22.63	7.50	2.37	39.68	42.91	7.75	0.252	0.106	2.38
				33.52	48.83	7.78	0.300	0.0902	3.33
						16.42	0.310	0.132	2.35

27	21.68	10.69	2.14	35.31	44.02	7.84	0.182	0.284	0.64
28	17.57	13.13	2.60	31.48	38.54	14.25	0.264	0.167	1.58
29	12.62	11.50	3.48	30.30	45.15	9.57	0.365	0.157	2.32
30	33.74	9.69	1.89	38.74	38.76	10.92	0.139	0.0732	1.90
31	28.95	10.94	2.52	35.41	39.21	11.92	0.269	0.108	2.49
32	25.59	14.56	2.51	29.74	35.88	17.31	0.353	0.256	1.38
33	20.37	13.19	2.06	27.23	37.84	19.68	0.800	0.344	2.33
34	18.52	11.56	2.82	30.71	43.50	11.41	0.329	0.240	1.37
35	38.06	10.38	2.80	30.10	37.71	19.01	0.314	0.124	2.53
36	24.44	6.38	3.31	37.62	46.70	5.99	0.265	0.123	2.15
37	35.27	3.31	3.01	38.64	48.11	6.93	0.287	0.200	1.44
38	19.52	17.88	3.04	27.93	39.41	11.74	0.208	0.231	0.90
39	34.33	10.00	3.02	25.28	40.08	21.62	0.294	0.139	2.12
40	23.03	9.25	2.63	23.94	39.68	24.50	0.424	0.583	0.727
41	15.29	11.44	3.62	27.98	47.68	9.28	0.190	0.127	1.50
42	20.95	9.94	2.37	28.81	46.35	12.53	0.585	0.239	2.44
43	19.18	10.19	1.91	31.32	42.10	14.48	0.149	0.111	1.34
44	20.99	11.06	2.86	29.01	43.32	13.75	0.171	0.115	1.49
45	27.56	4.26	2.57	41.74	43.31	8.12	0.212	0.0591	3.59
46	24.40	11.00	2.47	38.27	38.05	10.21	0.277	0.168	1.65
47	27.95	7.75	1.91	39.68	42.91	7.75	0.252	0.106	2.38
48	22.63	7.50	2.37	33.52	48.83	7.78	0.300	0.0902	3.33
49	18.65	14.13	3.67	30.18	35.60	16.42	0.310	0.132	2.35
50	21.68	9.88	2.58	33.58	45.96	8.00	0.244	0.109	2.24
51	19.86	10.75	2.10	29.29	41.95	15.91	0.221	0.154	1.44
52	23.58	9.56	3.93	33.53	45.42	7.56	0.218	0.142	1.54
53	14.99	8.75	2.46	30.69	45.99	12.11	1.630	0.232	7.03
54	27.31	10.44	2.07	31.07	42.53	13.89	0.415	0.107	3.88
55	23.33	6.11	2.69	36.61	47.80	6.79	0.122	0.0869	1.40
56	24.40	9.88	2.63	28.96	46.03	12.50	0.165	0.135	1.22
57	20.05	6.31	3.23	35.28	44.93	10.25	0.388	0.290	1.34
58	22.52	9.81	2.07	28.17	45.70	14.25	0.428	0.107	4.00
59	22.57	6.16	3.02	34.56	49.09	7.17	0.107	0.0889	1.20
60	19.14	13.94	2.54	32.98	41.36	9.18	0.211	0.177	1.19
61	15.23	12.25	3.47	31.01	41.49	8.78	0.342	0.143	2.39
62	26.00	11.75	3.69	33.50	43.17				
63									

58	22.52	9.81	2.07	28.17	44.93	10.25	0.388	0.135	1.22
59	22.57	6.16	3.02	34.56	45.70	14.25	0.428	0.290	1.34
60	19.14	13.94	2.54	32.98	49.09	7.17	0.107	0.107	4.00
61	15.23	12.25	3.47	31.01	41.36	9.18	0.211	0.0889	1.20
62	26.00	11.75	3.69	33.50	41.49	8.78	0.342	0.177	1.19
63	26.94	12.31	4.19	35.60	43.17	7.89	0.193	0.143	2.39
64	23.83	8.63	3.12	36.10	39.71	8.19	0.258	0.151	1.28
65	22.21	11.94	2.31	35.86	41.94	10.21	0.380	0.141	1.83
66	16.58	17.25	2.87	30.96	42.24	7.65	0.219	0.204	1.69
67	31.82	4.03	2.12	40.15	44.97	9.95	0.296	0.170	1.29
68	14.59	13.94	2.84	25.97	47.62	6.08	0.171	0.219	1.35
69	18.36	13.06	3.36	30.42	40.72	16.53	0.223	0.103	1.66
70	26.32	7.50	2.43	32.65	44.14	9.02	0.280	0.172	1.30
71	19.32	11.13	3.25	34.94	42.59	14.83	0.319	0.172	1.63
72	31.58	5.75	1.63	39.18	40.02	10.66	0.277	0.108	2.95
73	22.70	8.94	3.67	30.46	46.32	7.12	0.117	0.264	1.05
74	26.20	10.81	3.94	30.94	48.62	8.31	0.223	0.0853	1.37
75	34.84	4.76	1.65	37.28	43.46	10.85	0.749	0.287	0.78
76	32.69	10.06	2.78	35.77	48.36	7.95	0.455	0.299	2.51
77	16.80	13.44	2.16	26.64	43.30	8.09	0.210	0.226	2.01
78	17.40	12.06	2.49	35.32	38.76	19.00	0.319	0.138	1.52
79	24.00	8.75	3.07	41.22	39.35	10.78	0.321	0.178	1.79
80	18.34	10.56	2.31	37.32	40.36	6.60	0.218	0.154	2.08
81	15.88	10.88	2.91	25.05	42.14	7.67	0.157	0.0895	2.44
82	31.84	4.61	1.79	41.62	40.94	20.22	0.226	0.145	1.08
83	16.93	11.63	2.85	28.36	46.60	5.38	0.126	0.139	1.63
					50.33	6.83	0.155	0.0746	1.69
								0.203	0.76